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How Using The Physics Front Digital Library Can Support Best Practices in Science

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Introduction

What is a Digital Library?

A *digital library* is a series of activities, collections, services, tools, and people in support of the creation, dissemination, use, and preservation of information, data, and knowledge (Griffin, 1998). The Physics Front (<http://thephysicsfront.org>) is one such digital library collection for K-12 physics and physical science teachers developed under the larger umbrella of the ComPADRE Digital Library Collection.

ComPADRE is sponsored jointly by the American Association of Physics Teachers (AAPT), the American Astronomical Society, the American Institute of Physics, the Society of Physics Students, and the American Physical Society. It is funded by the National Science Foundation (NSF) within the larger National Science Digital Library (NSDL) Pathways Project. Eight Pathway projects exist in the NSDL, each of which is charged with making connections to and providing services for specific audiences, and engages existing community efforts in the selection, promotion, and recognition of quality resources (Mason, 2007).

What Do the Strands of Science Proficiency Look Like?

According to the report of the Committee on Science Learning, *Taking Science to School* (Duschl, Schweingruber, & Shouse, 2007), students should be able to

- know, use, and interpret scientific explanations of the natural world;
- generate and evaluate scientific evidence and explanations;
- understand the nature and development of scientific knowledge; and,
- participate productively in scientific practices and discourse.

These strands are the touchstone of science literacy, pointing K-8 teachers towards concrete applications of science concepts for the classroom (Duschl et al., 2007). The teacher's companion guide to the report, *Ready, Set, Science!* (Michaels, Shouse & Schweingruber, 2007), contains concrete examples with classroom vignettes applying these four strands to learning and teaching science in the K-8 classroom. Digital resources, such as *The Physics Front* (<http://thephysicsfront.org>), can support and augment these best practices to inform science curriculum at all instructional levels.



Figure 1. Applying technology to scientific practice

How Could The Physics Front Inform Middle School Science Learning?

The Physics Front (TPF) is a free digital library provided by the AAPT in partnership with the NSF and the NSDL, providing hundreds of lesson plans, field-tested labs, teacher content support, student tutorials, and simulations to suit the teacher's individual needs in four course levels: K-8 physical sciences, conceptual physics, algebra-based physics, and AP physics.

The materials contained within TPF collection have been reviewed and evaluated by teachers and editors. When a teacher registers and becomes a member of TPF Community, he or she will then have free and full access to all resources and features, including the ability to share and communicate with other educators, mentors, editors, and experts.

Registering a Profile on TPF

To become a member of TPF and obtain full access to the website's resources and user community, browse the website (<http://thephysicsfront.org>), as shown in Figure 2. To register, select "register" from the left navigation bar. You will be asked to fill in some required information, which will never be accessible to third parties. For more information on TPF's privacy policy, please go to <http://thephysicsfront.org/webdocs/Privacy.cfm>.



[Lesson Plans](#) | [Activities](#) | [Labs](#) | [Assessments](#)

[Physics Front Registration](#)

Step #1
Register

Physics Front Registration

Submit the form below to join the Physics Front and ComPADRE network. As a registered user you may participate in our discussion forums, recommend or comment on resources, and collect, annotate, and organize items in your personal filing cabinet.

Registration is free and any information provided will only be used in accordance with our [privacy policy](#) and will not be distributed to third parties.

Required Information:

Country:

Email Address: **Type:**

Your Password:

Confirm Password:

First Name:

Last Name:

Are you a new physics teacher? Yes or No

Would you like to receive email updates from the Physics Front? Yes or No

Additional Information (not required):

Organization:

Org Abbreviation:

Address 1:

Address 2:

City:

State:

Zip Code:

Phone: **Type:**

Chat Handle: on

Courses I teach:

- Conceptual Physics**
- Algebra-Based Physics**
- AP/Calculus-Based Physics**
- Physical Sciences K-8**

Figure 2. How to register with TPF community

Once you have registered, you will be able to create a profile on TPF. Profiles reflect a member's affiliation, contact information, and as much personal information as a member is comfortable revealing. After registering and creating a profile, shared folders are listed so that others in TPF community can share resources (see Figure 3).



Figure 3. Example of user profile

Who Uses TPF?

TPF materials have the potential to serve an entire spectrum of users with physical science and physics resources for grades K-12. These users include the following but are not limited to experienced teachers, new and cross-over teachers, students, and mentors. A complete array of services is offered that allows a teacher to:

- Collaborate and share selected materials with other teachers and students;
- Browse the collection by course type, grade level, or topic for units and unit elements;
- Access resources that include high quality labs, tutorials, teacher reference materials, lesson plans, activities, and assessments with many items to choose from at all levels of instruction;
- Setup and use the filing cabinet to store, organize, and collaborate with students and others;
- Upload links and teacher-developed materials for evaluation and inclusion in TPF repository; and,
- Help to build a community of teachers with common interests and needs by sharing hints, teaching practices, challenges, and successes.

How is TPF Organized?

Items within the collection are listed as unit elements, which are organized by subject and are examples of web resources for that topic (see Figure 4). Resources are included based upon quality of content, ease of use, alignment with standards, and best practices for the teaching of physical sciences. Example unit elements that can be arranged to build curricula are included, along with activities, labs, lesson plans, simulations, assessments, and curriculum support materials.

From the home page, the user can browse featured items and resources, download featured lesson

plans, search the items in the collection, and can go directly to the units and unit elements using the left navigation menu. All resources are available to registered users only.

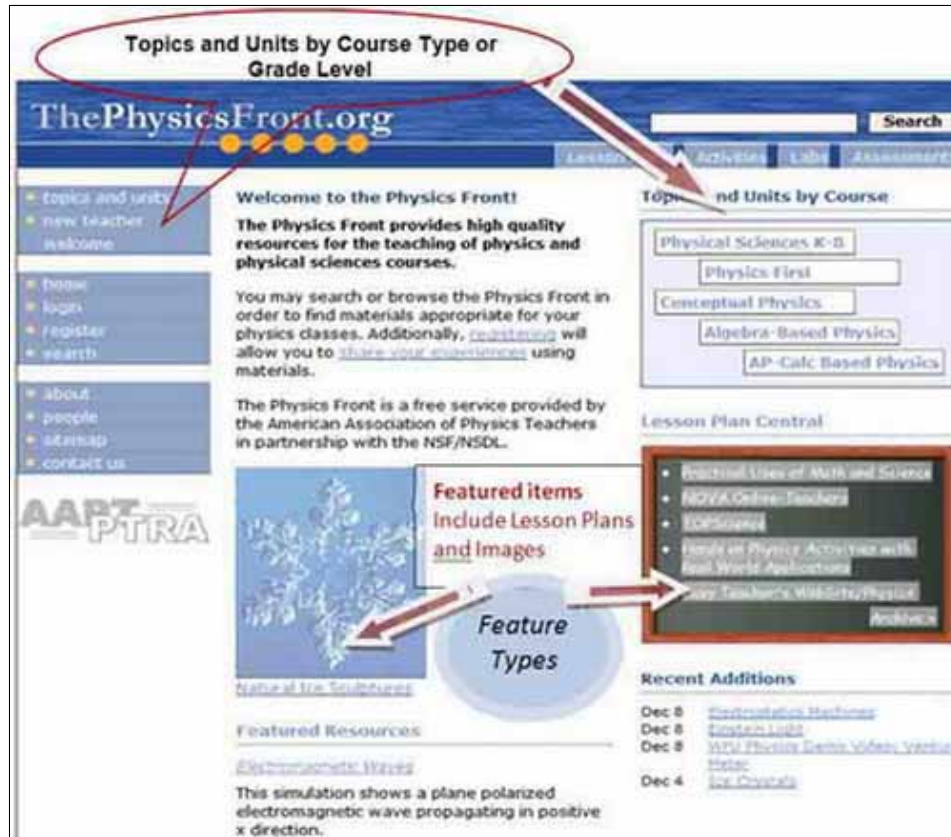


Figure 4. Organization of the home page on TPF and feature types

Searching for Resources on TPF

A search can be filtered by item name, category, general subject, specific subject, resource type, target grade level, or user role as shown in Figure 5. The user can also search within all of the ComPADRE collections.

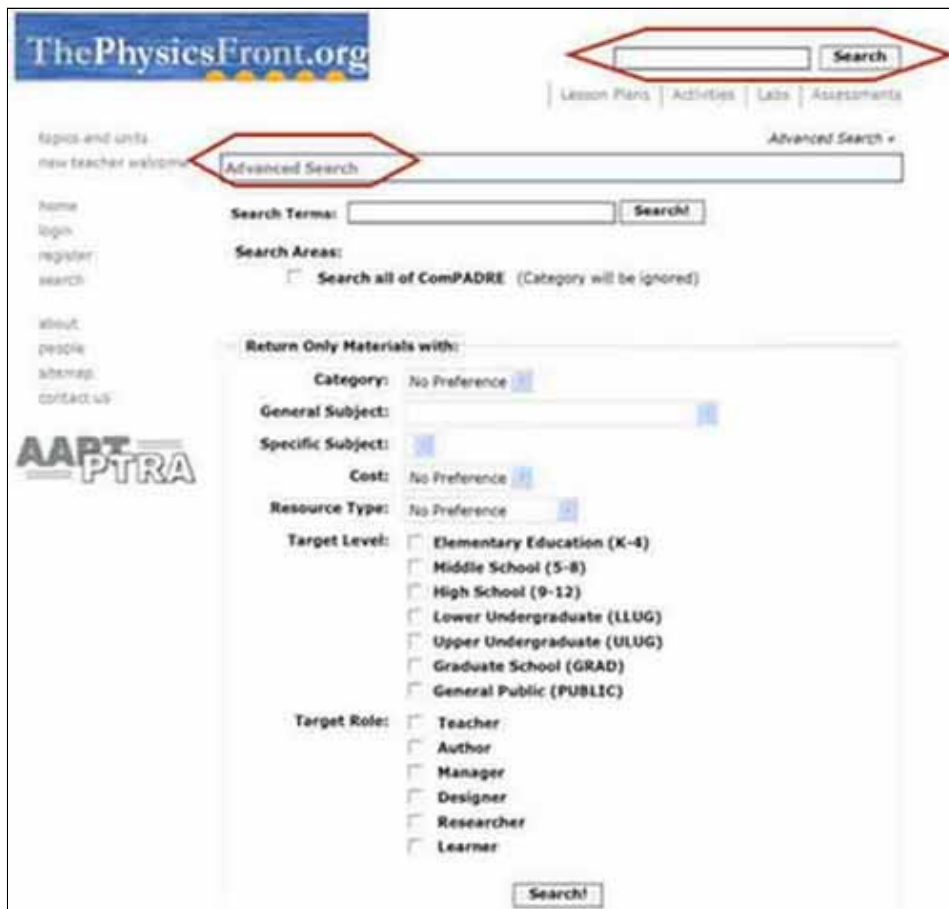


Figure 5. TPF search options and categories

An advanced search can also be done by topic, category, subject area, or keyword. Possible topics include measurement, motion, forces, momentum, energy, springs, heat and temperature, wave energy, electrostatics, electricity and circuits, magnetism, electromagnetism, optics, particles and interactions, and astronomy. Within each topic, elements are found that allow the teacher to assemble lessons on any physical science topic.

For the New Teacher

Located on the left navigation menu are links to materials especially for new teachers, advanced search options, and other features to be highlighted later in this article. Under each course type, topics and units are listed as shown in Figure 6. Teachers of elementary, middle, or high school physical science or physics can find lesson plans, activities, labs, and assessments.



Figure 6. Materials for new teachers, topics and units, and course types

K-8 teachers and teacher mentor materials have been selected to be developmentally appropriate and safe for use in pre-high school classrooms. For example, Figure 7 shows a screenshot when Physical Science K-8 and course type was selected. The topic list is consistent across all course types but the unit elements were filtered for middle and elementary school use. Since some of the items in TPF are appropriate for more than one course and may be found by searching across more than one course type. Within each topic, units are described by example unit elements, which are organized by categories of activity, content support, tutorials, and assessments, depending on the type and number of resources available for that category.



Figure 7. Topics are listed under each course type

One or more unit elements are listed under each unit as seen in Figure 8. The "bread crumbs" (italicized text to show the path the user has taken) in the upper left corner of the screen will help teachers navigate through the materials. Clicking on the "plus" sign to the left of each unit element will reveal more information about that element and collection items listed underneath. The categories include activities, content support for teachers, student tutorials, assessment, references, and others.

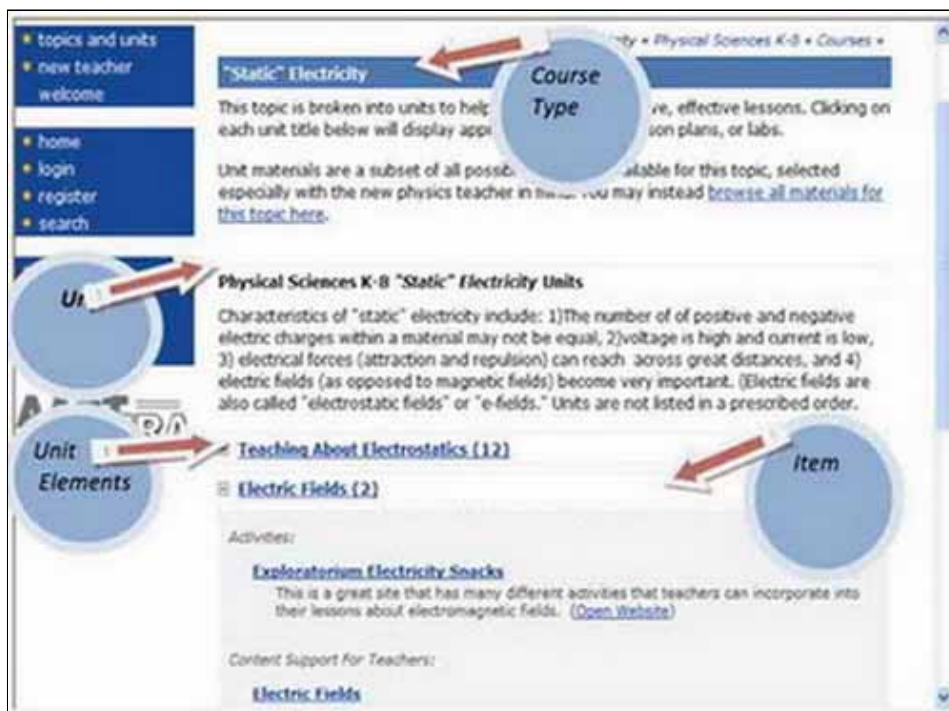


Figure 8. Unit elements and items

Clicking on the item will bring up the detail page containing a short description, a link to the material, URL or location in TPF repository, and links to other relevant subjects and citations. Also available on each detail page is information about the intended user and citations. If a teacher has a comment or suggestion, clicking on the "Suggestion" tab will provide an opportunity to share feedback.

The screenshot shows the 'Exploratorium Electricity Snacks' item detail page. On the left is a navigation menu with links for home, login, register, search, about, people, sitemap, and contact us. The main content area features the title 'Exploratorium Electricity Snacks', the author 'written by Exploratorium', a short description, and a URL: <http://www.exploratorium.edu/snacks/cone/electricity.html>. Below this are two tables. The first table lists subjects, levels, and resource types. The second table lists appropriate courses, categories, and intended users. At the bottom, there are tabs for 'Primary Details', 'Citation Formats', and 'Suggestion?'. A callout bubble labeled 'Item Description' points to the main content area.

Subjects	Levels	Resource Types
Electricity & Magnetism - Electrostatics	- High School - Middle School	- Activity

Appropriate Courses	Categories	Intended Users
- Physical Science - Physics First - Conceptual Physics - Algebra-based Physics - AP Physics	- Activity - Laboratory	- New teachers - Learners - Teachers

Figure 9. Item detail page

How Do TPF Tools Work?

The *filing cabinet* is a place for users to save, organize, and annotate resources. The link to the personal filing cabinet is in the upper right corner as shown in Figure 10. In the filing cabinet, a teacher can create folders and sub-folders for storing materials from the TPF.

Items are added to the filing cabinet through a list generated by searching or browsing. Items in the filing cabinet can also be annotated or moved to different folders. Citations are also generated for folders.

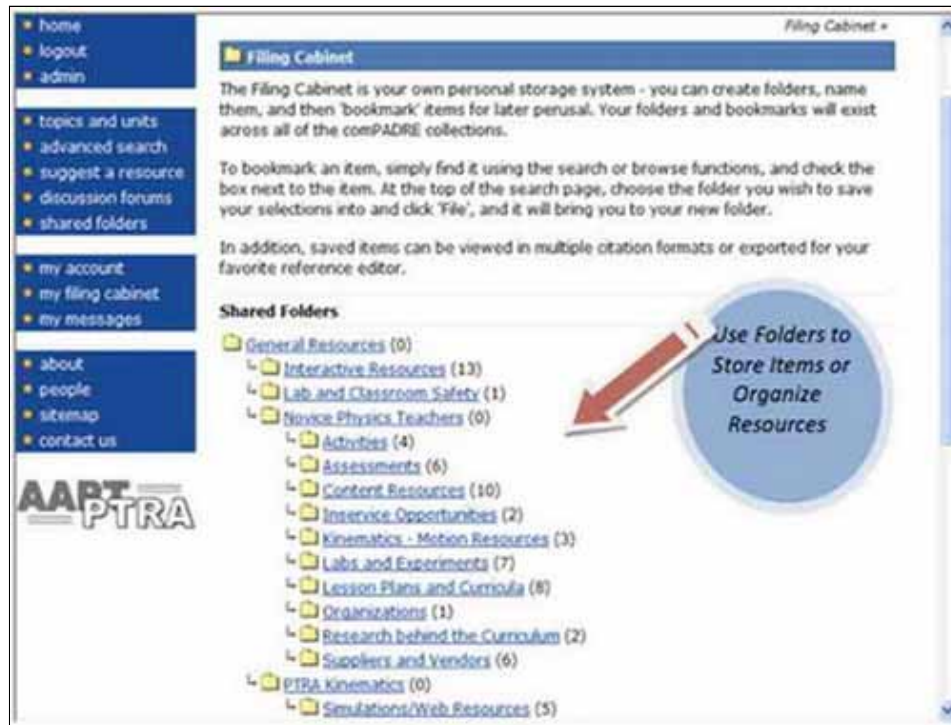


Figure 10. Example filing cabinets

Discussion Forums

The Discussion Forums are tools for teachers, mentors, students, and other users to communicate and share ideas and common interests. They offer a place for new teachers to connect with each other and to ask questions. See Figure 11. The TPF filters for content. Discussion questions and suggestions are forwarded to the editor's email. Only registered users can access the forums.

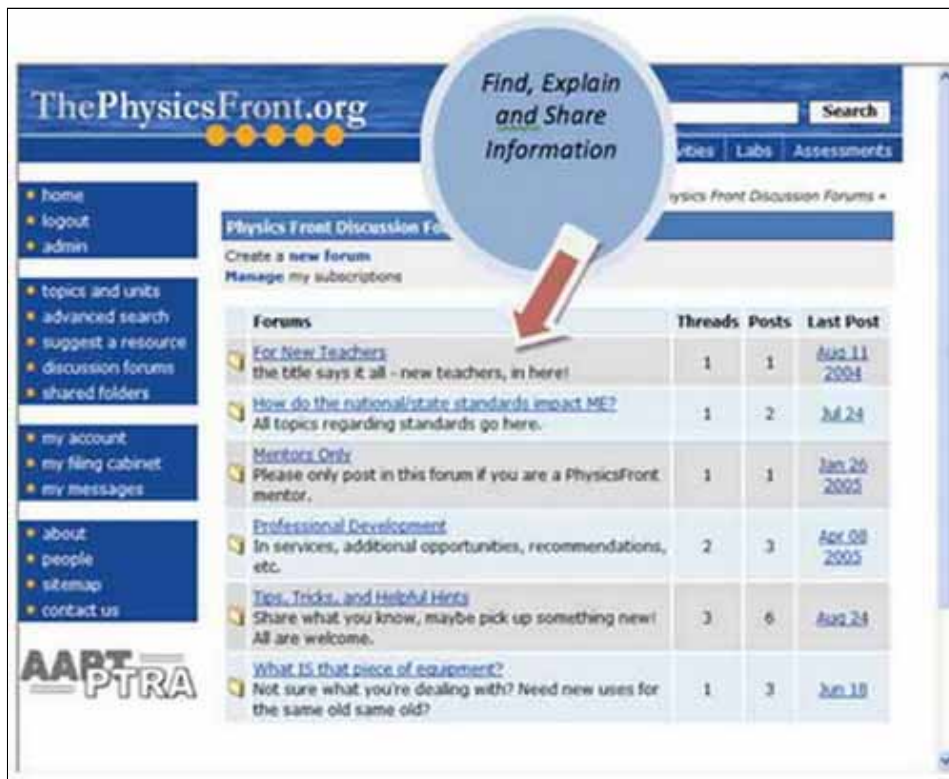


Figure 11. Discussion forums.

Other Features of TPF: Image, Lesson Plan, and Featured Items

Additional features found on TPF include lesson plans, as well as featured images and items. Registered users are able to access the archives (see Figure 12). In addition, mentors will be able to use their own lesson plans, simulations, and other creative materials as models in TPF. The TPF editorial staff will review, process, and add these exemplary teacher-made materials to the collection.



Figure 12. Features on TPF

Constructing a Lesson: An Example Vignette

TPF resources are intended to help teachers to enrich students' experiences as they learn physics concepts. Acknowledging common needs among various science community members, special care is taken to suggest and organize access to physics resources separately and appropriately for elementary, middle school, and high school teachers, as well as their students. The following is an example of a possible situation in which a teacher might use TPF to construct a lesson.

Susan is a new middle school science teacher who will be teaching a lesson on Newton's Laws next week. She has searched the web for good materials and found a detail page on TPF as shown in Figure 13 below.

The screenshot shows a web page titled "Detail Page - Search Results -". At the top right, there is a "Save into folder:" button and a "Save" button. Below the title "Newton's Laws", it says "written by Robert Hatch" and "Precollege Status: A Control Menu". The main text describes the page as a lesson plan for Newton's laws. A URL is highlighted in red: http://web.cles.ufl.edu/users/rmatch/pages/05-SecondaryTeaching/NSF-PLANS/2-2_NE...

Subjects	Levels	Resource Types
Classical Mechanics - Applications of Newton's Laws	- High School - Middle School	- Lesson plan

Appropriate Courses	Categories	Ratings
- Physical Science - Physics First - Conceptual Physics - Algebra-based Physics	- Lesson Plan - Activity - New teachers	

Primary Details Post a Comment Related Material Citation Formats

Save Item Admin Suggestion?

Intended Users:	Teacher Learner
Formats:	text/html image/gif
Access Rights:	Free access
Restriction:	Copyright 2004: Copyright, Robert A. Hatch
Record Creator:	Metadata instance created Jul 22, 2004 by Melanie Carter
Last Record Update:	Jan 04, 2005 by Bruce Mason

Figure 13. Detail page of items on TPF

She notices that she can follow the link to look at resources and also notices that these materials are appropriate for middle or high school students. Susan decides to visit the Physical Science K-8 menu on the home page to search for some simulations to support this unit for her students. She then selects "Forces" from the topic list and "Newton's First Law and Inertia" from the unit elements available. She then decides to investigate the "Inertia Game" item and believes that it is a nice simulation aimed at an appropriate grade level and ties to appropriate standards and benchmarks. Although she feels confident that these materials will work well with her lesson on Newton's First Law of Motion, TPF also allows her to contact her mentor. Through the shared files in her filing cabinet they can collaborate on her choices.

Sharing Resources: Contributing to TPF

There are many ways that users can contribute to TPF. Users can share appropriate courses and categories. Citation information is included with existing resources so that users can make suggestions about specific resource items. The filing cabinet allows mentors to point other users toward resources as shown in Figure 10. Teachers, educators, and physicists sharing their best resources and links with new and experienced teachers contribute to TPF community. Figure 14 details how a user goes about

submitting a new item to TPF.

The image shows a screenshot of a web page titled "Submit a Suggestion" for the Physics Front collection. On the left, there is a navigation menu with a "Submit Material: And/Or Share Favorite" button highlighted by a red arrow. The main content area contains the following form fields and instructions:

- Buttons: Simple Form, Full Form, Suggestion Archive
- Instructions: "Fill in the form below to suggest a material for the Physics Front collection. An editor will review your submission and, if suitable, a full record for the material will be created. Please use the Full Form for non-English materials." and "You may view the status of your past suggestions here. If you have any questions about a submission, or if you are an author who wishes to make a large number of submissions, please contact the webmaster at editor@thephysicsfront.org."
- Field: * Existence: Before continuing, please check to ensure the resource isn't already in our approval process.
- Field: * Item Type: Web (dropdown menu)
- Field: * Title: [text input]
- Field: * URL: [text input]
- Field: Mark if this resource doesn't have a webpage.
- Field: or attach a file: [file upload] [Browse]
- Field: Include file in full-text searching.
- Field: * Description: [text area]
- Field: Author: [text input]
- Field: Other Comments: [text area]

The AAPT-PTRA logo is visible in the bottom left corner of the page.

Figure 14. Submitting content—suggesting TPF materials

TPF editor manages a broad spectrum of digital content by working with other ComPADRE editors, outside projects, and science organizations to provide a coherent service. To help achieve this goal, TPF collection works to comply with existing national and international projects standards, such as those created by the NSDL, the Open Archives Initiative, or the federal accessibility guidelines.

TPF is committed to providing the most current resources and up-to-date materials possible in order to enhance physics and physical science teaching at all levels. We are dedicated to improving physics and physical science instruction by providing community-building through our collections. Future updates will include more standards alignment and concordance, links to special topics blogs and NSTA webinars, and contributions by our new associate editors. A mentoring project for new teachers is planned along with a mentor-training area. New wikis, blogs and web seminar features are also coming soon.

Other ComPADRE collections can be found at <http://www.ComPADRE.org> as shown in Figure 15.



Figure 15. ComPADRE portal

Our Editorial Staff

ComPADRE started from the AAPT's Physical Sciences Resource Center, designed and developed by Warren Hein while he was Associate Executive Officer of the AAPT. Bruce Mason is the PI for the entire ComPADRE Pathways Project. The ComPADRE Project Manager is Caroline Hall. Lyle Barbato is the lead programmer and Matt Rigsbee is the web artist and programmer. TPF managing editor is Cathy Mariotti Ezrailson; associate editors include Trina Cannon and Mike Jabot. For more information on ComPADRE visit <http://thephysicsfront.org> or contact the editors. Watch for subsequent articles on specific best practices in teaching physics and physical science using this digital library.

About the Authors



Cathy Mariotti Ezrailson, Ph.D. is an Assistant Professor of Science Education at The University of South Dakota in Vermillion, SD. She has been an American Association of Physics Teachers' Physics Teaching Resource Agent since 1992. She has taught middle school science, AP physics, scientific research and design, computer technologies, geology and chemistry in public schools and community colleges for more than 20 years. She currently teaches physical science and science methods for elementary, middle school, and high school science education majors, as well as graduate courses in science education. Her current research areas include "Are We Teaching Science Safely in South Dakota Schools?", "Interactive Science for the English Language Learner: Two ELL Populations Compared," and "Science and Technology is Also Me"—A Middle School Girls' Physical Science and Technology Summer Experience. She has designed and implemented the Explicitly Modeled Interactive Techniques (EMIT) best practices in science teaching model for classroom grades 6-20 and is currently managing editor of The Physics Front.org—a digital library collection for K-20 physics and physical science teachers, students, and teacher educators.

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