Online Teaching Resources: Where in the WWW are They?

One of the joys of teaching physiology is that it is best understood as principles rather than factoids. Conductance, gradients, and flow apply not just to one system in the living organism but to many. At the same time, our ever-growing understanding of how general principles function at each level—from molecular to whole organism—challenges physiology educators who must put considerable effort into keeping the content of their courses up to date. Similarly, as physiology research tells us more about the functioning of living systems, educational research provides important perspectives on how people learn (1, 2). In a field of exponentially expanding content knowledge, our goal cannot be simply to provide students with an accurate snapshot of “what we know now.” It also must include development of skills for lifelong learning. To address this, education increasingly strives to create student-centered learning environments. Layman (4) describes this well:

“The previously dominant view of instruction as direct transfer of knowledge from teacher to student does not fit the current perspective. The present view places the learner’s constructive mental activity at the heart of all instructional exchanges. This does not mean that students are left to discover everything for themselves. . . . Instruction must provide experiences and information from which learners can build new knowledge.”

How can we keep content current and find effective teaching materials that create a student-centered learning environment? Many physiologists turn to the Internet. When you are polishing up your PowerPoint presentation for Monday’s lecture, you want to find accurate information and appropriate graphics that meet your needs. And you want them fast. The difficulty lies in finding what you want within a reasonable amount of time. The solution lies in where you look, and, thanks to some recent developments in digital libraries, you have a number of options.

**Web Search Engines.** For most of us, our first stop is our favorite web search engine. Whether it’s Google, Yahoo, Ask, or any of the other major engines, the rules are the same. You enter a search term(s) and you get back everything the engine can find. Then it’s your job to decide what is accurate and useful. The power of these engines allows you to identify a huge number of web pages on the topic of interest, but you must then browse through them. If you are looking for something very specific and can use very specific search terms, the search engines are usually on target. For example, if a colleague mentioned she has a great animation on oxygen diffusion on her web page, you can probably give some very specific search terms (e.g., her name, institution, and “oxygen diffusion”) and a large search engine will get you there quickly. If you just type “oxygen diffusion, animation” in the search terms, refill your coffee mug . . . you’ll be browsing for a while. Another strength of the big search engines is to help you find up-to-the-minute media reports on health and science topics. For example, on the morning on which the FDA released the fat-blocking weight-loss pill orlistat for nonprescription use, an 8:30 AM Google search gave me links to official release documents, newspaper items, and a number of blog entries.

**Digital Libraries and Portals.** In 1995, the National Science Foundation (NSF) launched plans to establish a national online digital library system focused on providing resources for improving teaching and learning for science, technology, engineering, and mathematics education at all levels. Digital libraries differ from typical websites in that they not only store online resources but catalog them with specific information that allows the library to be more easily searched and share its information with other libraries. Over the next decade, dozens of science-focused digital libraries were developed with NSF support.

Digital portals allow you to search multiple digital libraries all at once. For example, the National Science Digital Library (NSDL) site (http://www.nsdl.org) serves as a portal to more than 800 collections of teaching resources. Like the big web search engines, the power of digital portals is in the massive number of objects they can access quickly. The difficulty lies in their generality. NSDL, for example, has resources ranging from research journals to taxonomy keys to science activity sheets for kids. It’s a more focused collection than the whole web but not as specific as many educators want.

**BioSciEdNet Portal.** Recognizing that most science educators want to find resources in their specific field, in 2004 the NSF began funding the Pathways NSDL projects. Pathways projects provide stewardship for the content and services needed by major communities of learners (5). The NSDL Pathway to the Life Sciences Online Portal is BioSciEd Net (BEN) (http://www.biosciiednet.org), housed at the AAAS. BEN provides links to resources from more than 20 professional society digital libraries, including the APS Archive of Teaching Resources. BEN users have access to teaching resources in diverse life sciences fields, including physiology, microbiology, ecology, toxicology, plant taxonomy, and signal transduction. There are two notable differences between BEN resources and those in the NSDL. First and most importantly, every BEN resource has been peer reviewed for scientific accuracy by the contributing society. Second, while NSDL allows the user to search by topic, BEN allows the user to also search by title, discipline, resource type (e.g., article, PowerPoint), pedagogical use, educational level, author, and author’s institution. The user can quickly find what they want among BEN’s growing list of resources.

**APS Archive.** As noted above, one of the contributors to BEN is the APS Archive of Teaching Resources (http://www.apsarchive.org). The Archive is a free digital library providing access not only to APS teaching-related publications (including articles from *Physiology and Advances in Physiology Education*) but also to materials contributed by physiology educators worldwide and by collaborating societies. The Archive houses materials to support instruction in the graduate, medical, undergraduate, and K-12 settings. Each resource offered in the Archive has passed through a review process and meets specific standards for scientific accuracy and use of animals/humans in teaching. The APS library not only accepts and encourages contributions by individuals, but it has ongoing collaborations with other societies (Human Anatomy and Physiology Society, Society for Developmental Biology, International Union of Physiological Sciences Education Committee, and National Association for Health and Science Education Committee).
Help you update Monday’s lecture on populated, and reviewed. If you plan to use a digital library, it’s worth taking a minute to read about how it is constructed, populated, and reviewed.

But can this wealth of information really help you update Monday’s lecture on hypoxia? You go to Google to search “COPD” (chronic obstructive pulmonary disease) for some recent health news articles to use as an interest grabber at the start of your lecture. But you also want to improve your slides on hypoxia. You search “hypoxia” and Google provides links to 1.4 million web pages. This is a rich collection, to be sure, but who wants to look through that many web pages? A quick search of the NSDL collection for “hypoxia” provides you with links to about 1,700 resources. However, the vast majority of these links are to research articles. Many of these describe hypoxia in microbial populations in oceans. Not exactly what you wanted but you’re getting closer. If you search BEN for “hypoxia,” you get a list of 15 peer-reviewed items. Some of these are environmental studies articles. Browsing through them, one looks of interest: “Two-Dimensional Oxygen Map for Graphic Representation of Different Hypoxic Conditions” (3). Clicking on this item takes you to the pdf of the article at the APS Archive of Teaching Resources. The article has a nice graph that can help you explain the difference between hypoxia and hypoxemia and how they relate to different medical conditions. You download it and drop the graphic into your PowerPoint. You take a moment to search the Archive for additional resources on hypoxia and hypoxemia and find 9 or 10 good ones. You save them to a folder in the “My Archive” toolbox and email the link to your co-instructor for the course. You’re done but, if you started with a big web search engine like Google to search “hypoxia,” it took you three searches at three different sites to get there. Next time, you can streamline this process by looking for scientifically accurate teaching materials first at a digital library with peer-reviewed materials. If you don’t find what you want, work backward through the more general portals and web search engines.

What if you wanted to make that lecture more “student-centered” and interactive? A colleague of yours swears by his new “clickers” that allow students to respond to questions in class and immediately graphs their responses. You want a little more information on “interactive lecture” and “student response system.” Google provides you with some nice links to sites explaining what interactive lecture is (6) and how student-response systems can impact teaching and learning (7). BEN gives you 200+ links to “lectures” and the APS Archive gives you 37 “lecture” links, many with tips from HAPS or APS members on low-tech ways to increase the interactivity of your lecture. Now you have several techniques to try.

**Unsuccessful searches.** Of course, not all searches are this successful. Before giving up, try a number of different search terms and remember that using fewer terms often yields better results, especially at digital libraries. As you add more search terms, more items are taken out of your possible search results list.

How can we make these libraries more robust and responsive to your needs? Contribute! Many digital libraries are looking for contributions from users. The APS Archive includes more than 1,000 resources; about 10% of these are user-contributed items, including PowerPoint files, graphics, notes, examples, case studies, animations, web sites, and simulations. Sometimes the simplest thing—your rubric for grading case study reports—can be the very thing your colleagues would like to find. Authors retain copyright for their materials and can publish an abstract on their contribution in *Advances in Physiology Education*. If you are interested in contributing to the Archive or one of the BEN libraries, please contact the APS Education Office at education@the-aps.org.

**References**


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**Other Digital Libraries.** There are an increasing number of digital libraries of use to the physiology educator. Some, like the Health Education Assets Library (http://www.healcentral.org), offer high-quality digital images for educational use. Merlot Biology (http://biology.merlot.org) offers resources on both content and pedagogy, and AAMC’s MedEd Portal (http://www.aamc.org/medportal) offers tutorials, cases, lab manuals, evaluation forms, faculty development materials, and virtual patients. These digital libraries have review processes in place to ensure that the material found there is valid. It’s important to note that not all digital libraries do so. We encourage students and educators to be sure to answer three questions before using materials from any web site: “Who wrote this? Why did they write it? What evidence is there that this material is valid and up-to-date?” Similarly, when we visit digital libraries, we need to ask, “Who developed this? How did they select the material housed here? What review process did they use in vetting the material?” Many libraries, such as those at APS, BEN, Merlot, AAMC, and HEAL, invest considerable time in reviewing the materials and ensuring that the data that describe them are accurate. Other digital libraries use “web crawler” programs to identify resources on the web that match certain parameters such as keywords. The program automatically generates cataloging data without the review of a content expert. If you plan to use a digital library, it’s worth taking a minute to read about how it is constructed, populated, and reviewed.

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**Dimensional Oxygen Map for Graphic Representation of Different Hypoxic Conditions**


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**APS members on low-tech ways to increase the interactivity of your lecture.**

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