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CSTA

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CJSE Goes OnLine

CJSE Goes OnLine. Your favorite science education journal (that is the CJSE journal, of course) has taken another step into the education future with this very first online edition of The Connecticut Journal of Science. Thanks to the prodigious efforts of editor Ray Delehant, we are proud to present the Connecticut Journal of Science to you in this online format. (Who said old dogs can't learn new tricks?). The online format offers many substantial features for CJSE members, not least, in these budget-conscious days, is the fact that it can be cheaply done and even more cheaply emailed to our membership. In addition to these immediate cost-saving benefits, we suggest that the online CJSE provides immediate and substantial benefits to you as well. First, it is always available; thereby alleviating those timeless incidents where you (and we) have accidentally misplaced the last issue, which seems never to be found again. Now the online issue can always be found stored in our computer's CJSE file for instant retrieval, or, if that fails, then it is merely an email away. Second, we are working to ensure that this and future issues (as well as past CJSE issues) will be archived in journal files available through the CSA website, csta-us.org thereby providing over 30 years of CJSE articles for your perusal.

Now that we have embarked on a new and exciting future for CJSE we need you (as usual) to help flesh out the journal with articles, book reviews, timely classroom tips and the like. In this day and age there are innumerable science topics on both national and local levels that prove suitable for an article. For example, every day and for most of us every night (at least during the week) we busily review and revise our classes for the next day and the day after that, discarding dated material and introducing new material, often based on media accounts, both printed and televised, that catch our interest. These make good classroom topics of discussion because chances are, if we have seen the newscast then many of our students have also caught the same broadcast, in between MTV and the like. For example, a March issue of Time magazine featured an article on plastics; a recent issue of Scientific American had an article about our cousins, the Neanderthals. We can even suggest some topics for articles such as "Thinking and Rethinking Coal Energy" based on the West Virginia mine disaster or, given the slew of recent earthquakes in Haiti, Peru, and China, an article reminding students about the "Mechanics of Earthquakes" is a timely topic as well. Closer to home, the continuing debate about Connecticut's Energy Needs for the Future should be balanced against the outcry over building new power plants, refurbishing old power plants, and the recent disaster in Middletown.

Finally, we suggest that if a topic is good enough to develop into a theme for the day for your science class then it is certainly worthy of an article for CJSE. And don't be deterred by short or long length as we welcome all ideas from lesson plans to book reviews. And, while we always hold a few articles for the next issue we are also always looking for contributions and we are especially happy to receive your manuscripts for publication in CJSE.

Although not originally planned as such, most of the articles in this CJSE issue focus on water that leads us to the idea that perhaps some future issues might have a topical theme. Examples of potential theme topics might include Ecology and Economics of Long island Sound, Climate, Weather, and Climategate, Wind Energy, Energy Concepts, Concerns, Adaptations and Uses in New England might prove interesting to CJSE readers and writers. Let us know your thoughts and concerns and, again, please consider writing you next article for CJSE.

An editors ramblings:

The delay in getting your publications on time to you has been due to an unrecoverable hard drive crash that was on my computer. (I'm not looking for sympathy here.)

After purchasing a new computer, it took awhile to restore software,fonts and files from an external hard drive. All files had been saved on the external Hard Drive, so files were not lost for the Newsletter or Journal. A certain "office" (name not mentioned) software was balky and troublesome to install. Since all files were in that "office" format, it took a while to get it straightened out and things are now back to normal.

Why am I mentioning this?

If you have lesson plans, grade information, lab procedures, stories and files that you consider too valuable to lose, go buy an external Hard Drive and back up your files. HD's are relatively inexpensive and can save you hours of anguish and frustration should the Hard Drive on your computer fail.

Ray Delehant

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Articles and Authors

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Ted Goerner – Photo of Clay head sculpture cast.

Web site promotes plant data as a novel educational resource

By Robert S. Capers, plant collections manager, and Donald H. Les, director
George Safford Torrey Herbarium, University of Connecticut

Natural history museums around the world house huge numbers of plant and animal specimens that are extraordinarily valuable to biologists and others. Most of these specimens, however, are too far away to be of practical use to Connecticut high school biology teachers.

Now, all over the world, information on millions of specimens is being made available to anyone with access to a computer and the internet. And, while the original intent of this international effort was to make the specimens more immediately available to the scientific research community, these specimens also represent an untapped resource for biology teachers, especially those working at the high school level.

The George Safford Torrey Herbarium at the University of Connecticut is in the forefront of online specimen databasing, and one of its educational missions is to provide a friendly environment where teachers can find suggestions for using the data.

The herbarium (known formally by the acronym "CONN") began putting information on its plant specimens into a database about 14 years ago and has hosted data online for nearly eight years. The databasing initiative picked up steam about a year ago, when the National Science Foundation awarded the herbarium a major grant to complete the databasing of its entire vascular plant collection within the next three years. The herbarium staff and student assistants now are well into the process. Information on more than 75,000 specimens – about 40% of the total – currently resides in the database and is freely available online (see http://bgbaseserver.eeb.uconn.edu).

As part of the databasing process, students enter information on a plant specimen's identity, the name of the collector, the date it was collected, where it was collected and all other information provided on the specimen label. Once entered in the database, that information can be accessed readily by users through web-based searches for use in many different analyses, including:

- Tracking the spread of invasive plants across the landscape
  - When was the species first observed?
  - Did it start spreading immediately, or was there a lag?
  - Do all invasive species behave the same?
  - Do invasives spread like a wave or do they advance in a more erratic fashion?
- Plotting changes in the abundance of native plants over time
  - Why might they decline?
  - How might changes in the Connecticut landscape affect plant abundance?
- Biodiversity: How many species occur in particular towns or counties?
  - Why might the number of species be greater or less in one area than in another area?
  - What biases might exist in the dataset?

The UConn herbarium's search page (which can be accessed at: http://bgbaseserver.eeb.uconn.edu/databasesimple.html enables students to search for a plant species and to obtain information on all records of that species in the database. A search of red maple (*Acer rubrum*), for instance, retrieves 137 records ranging in age from 1883 to 2009 (Fig. 1). The locations where all the specimens were collected can be mapped easily (except imperiled species, whose locations are kept secret), and all the data can be downloaded into an Excel® file for further statistical analysis or to make graphs.

Fig. 1. The UConn herbarium's web page has a simple search page where students can request information on particular species (Top). The results (bottom) include a list of all the specimens of that species in the database (137 of them in this case)

The herbarium's web site also has a new section devoted specifically to high school biology teachers and their students. One page provides information on how professional biologists use the database in their own research. We hope this overview will help students and teachers to develop their own ideas on how the data could be put to work. The web page also provides examples of simple maps and graphs (Figs. 2, 3), which are available online or could easily be prepared by any high school student using Excel® (almost all of the graphics on the website also were made in Excel®, as students will quickly recognize).

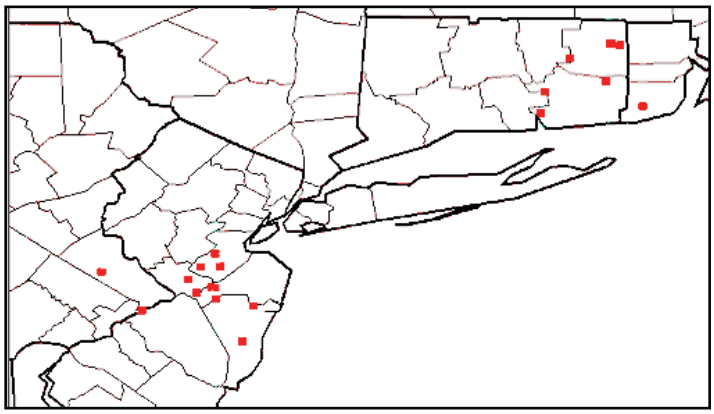

Fig. 2. A map showing the North American distribution of mud mat (*Glossostigma cleistanthum)* an invasive aquatic plant. Although this plant has not yet been reported from Long Island, that region occurs in the middle of the plant's known distribution, and the species grows in clear-water, sand-bottom ponds, which are common on Long Island. As a result, the Nature Conservancy was inspired to search for this invasive plant on the island. Maps like this can be generated easily using the UConn herbarium's plant database.

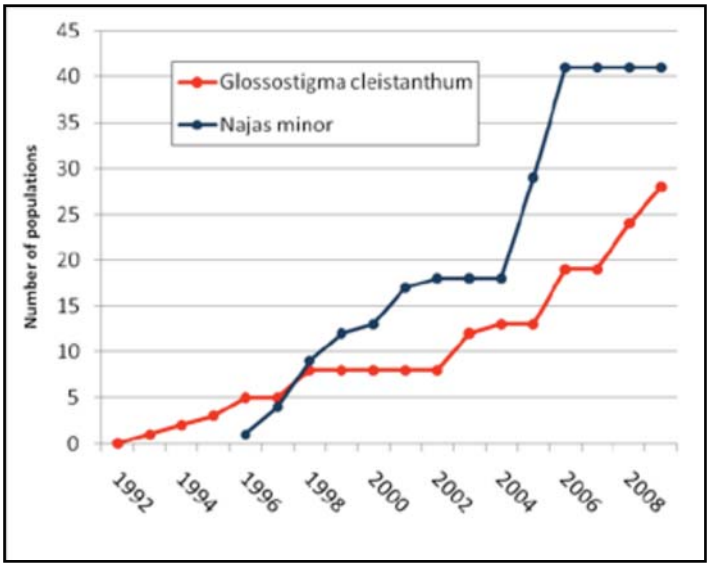

Fig. 3. Data downloaded from the UConn plants database can easily be plotted using programs like Excel®. The graph uses specimen records to compare how populations of two invasive species have increased since they were first found in Connecticut. This kind of information can help managers decide how to best allocate their limited resources' to programs for controlling invasive species.

In an effort to increase awareness of the herbarium database and to make it easier for teachers to use, we began working with high school and middle school teachers from Connecticut about a year ago. We asked them to help us provide materials that teachers would find most useful in achieving educational goals. The teachers prepared several lesson plans that make use of the database, and these have been posted on the herbarium's web site so that other teachers will consider their use in their own classes.

Two of the exercises concern the spread of invasive plants. They provide links to several web sites and ask students to read about invasive plants and to answer questions about them: How do invasive species get here? Why do we care about them? The exercises then direct students to the UConn herbarium database and prompt them to conduct simple searches on selected invasive plants.

One exercise developed by Marjorie Porter of the Somers public schools asks students to record the number of specimens collected before and after 1950 so students can see how quickly a species has spread. A lesson plan written by Jon Swanson of E.O. Smith High School in Storrs asks students to plot the number of purple loosestrife populations in 10-year intervals since the species arrived in the 1880s. Both lessons ask open-ended questions to encourage broad thinking about invasive species, and both include exercises that require the student to conduct additional online research.

The Lesson Plans

Here are lesson plans developed by Connecticut teachers for use with their students

Feel free to use these lesson plans and to modify them to meet the needs of your own students.

We welcome additional exercises that you develop for use in your own classroom. Please send them to robert.capers@uconn.edu so that we can post them here, making them available to other teachers.


Dating an Alein

In this exercise, students assemble information on non-native plant species - how they have increased in frequency in Connecticut and why they are ecologically important.


Tracking a purple invasion

Students use an online database to download data on the frequency and distribution of an invasive plant and then use the data to plot the species spread. They also investigate the properties of the plant and consider why we might care about invasive plants.

Fig. 4. The UConn herbarium's web site has several lesson plans developed by Connecticut biology teachers to take advantage of the information available in the plant database.

A unit written by Greg Schenk of the Greater Hartford Academy of Math and Science (also an alum of the Department of Ecology and Evolutionary Biology, which oversees the herbarium) instructs students in the preparation of plant collections for their own school collections. Students are encouraged to design a specimen label that incorporates their school logo. Properly pressed and labeled, such specimens could be formally deposited in the UConn herbarium, where they would be databased and made available online. These specimens then could be mapped by future students, who would be motivated by the discovery that they were collected at their own school by students who preceded them. The student collectors would realize that their specimens had been incorporated into an important scientific collection and that their contribution would assist anyone in the world doing research on that species. Furthermore, the student would see that his or her own name, identified as the collector of the specimen, would be preserved in perpetuity. In this way, students not only learn about the value of biological collections but also can contribute to growth of an important research collection.

The UConn herbarium is part of the Biological Research Collections, which are housed in a 5-year-old building constructed as part of UConn 2000. The herbarium shares its state-of-the-art collections space with invertebrate and vertebrate collections. All of the collections are used in the education of graduate and undergraduate students on the UConn campus, and specimens from all the collections are used by researchers internationally. In this new space, all of the collections have room to grow, which is a luxury many other collections do not have.

The animal collections also have growing databases of their own, and like plants, they also are valuable to biological researchers. However, at this time, the small number of animal specimens that have been databased limits their usefulness in high school classrooms. It is really the size of the herbarium database that makes it potentially valuable for the kinds of exercises that might benefit students at the high school level.

The herbarium's web site also provides links to other plant databases where similar information on specimens is available online, although some are less easy to use than the UConn site. In fact, more and more collections are being databased each year, and the number of tools that are available for processing these data is growing. The grand-daddy of all databases if the Global Biodiversity Information Facility (GBIF), which is a clearinghouse for information on more than 180 million plant and animal specimens housed in collections all over the world, including those at UConn.

In the past, biologists either would need to travel directly to collections in order to study specimens for their research or would have to request the loan of that material. Herbaria like UConn's still receive many requests for loans, and we also regularly arrange for specimens to be borrowed from foreign herbaria so they can be studied by our faculty and students. Previously, biologists could spend a large part of their careers traveling in order to see all the specimens necessary to study a particular taxonomic group. Today, digital information and images make specimens available almost instantly to any researcher worldwide. This factor greatly reduces damage (or even loss) that results inevitably from shipping old, fragile specimens around the world.

In addition to compiling data, the NSF grant has enabled the UConn herbarium to capture high-resolution digital images of its plant specimens. In many cases, a researcher can see enough detail in these digital images that he or she doesn't need to see the actual specimen. We already have more than 16,000 images online and are adding nearly 1,000 images each week as our project continues.

These digital images provide further avenues of inquiry to high school students such as those interested in studying the difference between closely related or morphologically similar species. For instance, very similar species in the genus *Eupatorium* (Joe-Pye weed) can be distinguished from each other by the length of leaves; one species is supposed to have leaves more than 15 cm long, and a second species' leaves are supposed to be consistently less than 15 cm. Are they, in fact? Are there better characters that could be used to distinguish between the species? Inclusion of metric scales and color references makes it possible to obtain precise measurements directly from these images, which could be used to address such questions.

The UConn herbarium web site also provides links to other plant resources that teachers may find useful in their classes. These include **YouTube** videos on plant pollination and insectivorous plants, fact sheets about global warming and biodiversity, and an exercise for teaching about plants by using vegetables and fruits commonly available at the grocery store.

We hope our web site for teachers will grow as teachers use our data and develop their own exercises. We will add information and lesson plans as we learn about them, and we hope teachers will direct us to relevant sites of which we are unaware. We hope, too, to begin working with educators at UConn's Neag School of Education to help us expand and refine our thinking about how specimen data can be incorporated in high school education.

Ultimately, we hope that, through exposure to the world of botanical research and the kinds of real-world problems that biologists address using biological collections, some of our most promising high school students will become interested in careers in biology.

Most important, we believe high school students can make very real contributions in the analysis of the huge amount of information that is newly available. Far more information is available than ever was before, and biologists don't know quite what to do with it all. We are working hard to think of new ways to process the data, but there is no doubt that inquisitive young minds can contribute to this process.

By helping to analyze the data, asking new questions and looking for patterns and trends, clever high school students and

Herbarium - continued, page 38

Assessment Continued from page 6

with both quality instruction and State test expectations. Well-designed open-ended questions can potentially have a wide variety of valid responses, and having a systemic way to answer and evaluate them is beneficial for teachers and students alike. Implementation of this design for responses sets high standards which emphasize the importance of quality work in the classroom and on State testing.

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Herbarium from page 37

their supportive teachers can join in the process of discovery that is at the heart of biology, helping us to better understand how the world works.

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Wastewater from page 15

The waste water operator has to test to measure the status of organisms to know what to add back into the beginning of the secondary clarifier to keep the population where it needs to be. The excess organisms are wasted or sent to the solids handling area, where they are mixed with the primary solids. The laboratory technician and operators will frequently look at the organisms under the microscope and document the types that are present and their apparent health. Treatment plants have to be very aware of the possible pollutants that the plant could expect to receive. If somebody discharges something to that plant that is poisonous to these organisms, secondary treatment can be wiped out and discharge permit requirements of the plant will not be reached. Fines may be given to the treatment plant if permits are not adhered to.

Waste water treatment plant LAWPCA

Waste water plants have helped many water bodies recover or maintain good water quality and are very important in keeping our valuable water resources clean.

Resources

To explore this topic in more depth, a web search of "Wastewater Treatment Plant Operations" will lead to many useful websites. Several useful sites are listed below.

http://www.gocolumbiamo.com/PublicWorks/Sewer/wwwtppg_4.php
http://www.sandiego.gov/mwwd/facilities/ptioma.shtml
http://www.lakelandgov.net/water/nothsidewrf.html
http://www.encinajpa.com/?page_id=ll

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