TECHSIGHTING
SOFTWARE

Visualizing a Changing World

Last year's El Niño and record temperatures worldwide focused the interest of teachers and students in the Earth and life sciences on global climate change. Numerous reports on the greenhouse effect appear in the media, but understanding the complexity of climate information is a challenge for almost everyone. WorldWatcher is a new (and free) software package that brings hard-to-grasp concepts of atmospheric science to life and helps students visualize and understand large sets of climate-related data.

WorldWatcher
SSciVEE: Supportive Scientific Visualization Environments for Education

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WorldWatcher was developed by researchers at Northwestern University with support from the National Science Foundation. The software contains a large library of Earth and atmospheric science data. Students may also enter their own data, although, according to the manual, the file import for raw data is somewhat complex and requires "advanced computer skills." The package is designed to provide students with easy-to-use tools to analyze and view large sets of planet-wide data.

The capabilities of WorldWatcher have been expanded from primarily creating climate visualization maps (Fig. 1) to include the display of line- and scattergraphs and the performance of calculations on data sets. Simple mathematical operations allow for analysis of the effects of climate changes on surface and water temperatures or on precipitation over the past several years. Data sets for many planetary phenomena have been added since the program's first release in 1996. These range from cloud cover, evaporation, and wind speed data to population density, carbon emissions, and political boundaries. Ecologists may have students plot vascular plant distribution and diversity, solar energy absorbed by plants, dominant vegetation, or chlorophyll concentrations in the oceans. Atmospheric data allow students to observe the greenhouse effect; incoming, absorbed, and reflected energy; and surface temperatures over recent time. Users may find it cumbersome that some of the data are displayed in the English measuring system. The data conversion function does allow the user to convert data into metric values, but it requires that the operator have a basic knowledge of the appropriate conversion equations.

WorldWatcher allows the user to customize output by altering the color of the map, its resolution, and the magnification of the displayed region. The interface is user-friendly and most operations are easy to perform. The Web version comes with a printable 140-page manual that is concise and well written. One important feature of WorldWatcher is the Information button on the toolbar, which gives the user access to an extensive glossary explaining the use and meaning of variables displayed at a given time. The program also contains files of references that were used to compile the data stored in its library. Some of these data can be viewed by simply following the links in the WorldWatcher background sections.

Additional assets to the software include the Notebook function, which allows instructors to create worksheets or problem sets about global warming, rising sea levels, or the greenhouse effect. Worksheets can be designed to contain links to sample data, to the appropriate section of the manual, or to detailed background information about a given problem in the worksheet. New projects and data sets are available for download from the WorldWatcher Web page on a regular basis.

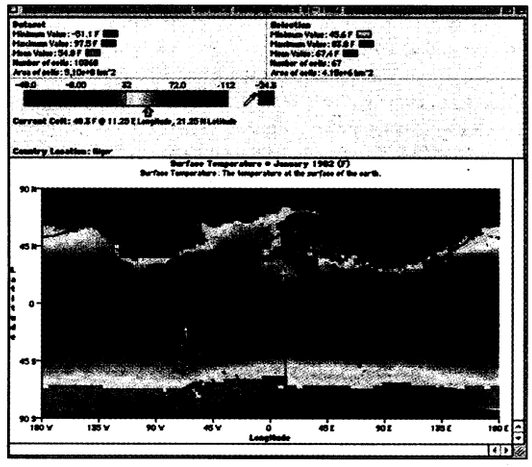

Fig. 1. Visualization created by WorldWatcher.

WorldWatcher's strength lies in providing an easy way to superimpose data or analytical results on world maps. The program is suitable for use by Earth science classes from high school through college. WorldWatcher can be obtained through the Internet or installed from a single CD-ROM, which is available free of charge from the Institute for the Learning Sciences at Northwestern University. Although WorldWatcher runs on both Macintosh and Windows platforms, only the Macintosh version can currently be downloaded directly from the Internet. The Web version runs best on PowerMacs with OS 7.0 or later (OS 7.5 is recommended), and requires QuickTime 2.5 or later.

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TECHSIGHTING
NET TIPS

Project Yourself!

A growing number of scientists are abandoning overhead transparency or slide presentations for computer-based ones, and with good reason. There are a number of advantages for running a presentation directly from the computer: the quality of the presentation is higher, the content can be modified right up to the last minute, there is no wait for the slides to be printed, and animation or sound (or both) can be added. But with new technology comes new hurdles to jump, and many scientists are facing such problems already.

Previously, we have covered ways to use graphics and animation to impress an audience (*1*, *2*). What we have not yet covered is that a computer-based presentation must run on a computer that plugs into a liquid crystal display (LCD) projector. Thus the major drawback of computer-driven presentations is that such projectors are expensive and may not always be available at the facility where you will be presenting your work. There is, perhaps, nothing more frustrating (and stressful) than arriving in the seminar room to find that there is no projector to plug your computer into, or that the available projector is not compatible with your laptop!

One way around this is to bring your own LCD projector. Until recently, however, this alternative was not viable for most of us because these projectors cost nearly $10,000. In addition, the projectors were bulky and heavy, making you feel like your travel plans had been turned into an expedition to Africa. The heft of those projectors was necessary because they needed space for adequate ventilation and cooling of the lamp and display engine, and decreasing size of the lens would distort projected images.

Thanks to a number of technical advances and design changes, a number of lightweight portable LCD projectors have

recently hit the market. These portable projectors are so popular that they are the fastest growing market segment among projectors. When looking to invest in such a device, there are three variables you should keep in mind: brightness, weight, and price. It's a fair bet that increased brightness comes at increased weight and increased price. So, you need to find the projector that will suit, not exceed, your needs.

There are two resolution standards among projectors: SVGA and XGA. SVGA (Super Video Graphics Array) offers a lower resolution of 800 pixels by 600 pixels and is the older standard. XGA (eXtended Graphics Array) offers a higher resolution of 1024 pixels by 768 pixels and is the more recent standard available in most new laptops. For best results, you should choose a projector with the same native resolution as the computer with which it usually will be used. When in doubt, an XGA projector will be your best bet because new notebooks now come with XGA displays.

It is worthwhile to be familiar with a number of terms when reading the various product reviews. The lumens measurement quantifies the total amount of light that reaches the screen, and thus gauges the brightness of each projector. The contrast ratio indicates the difference between white and black in the image. The brightness variance indicates the difference between the brightest and dimmest measured points on the screen when projecting an all-white image.

After analyzing a number of product reviews, we selected the following projectors as good first choices: Compaq MP1600 ($4500; 4.2 pounds), InFocus LP400 ($3300; 6.8 pounds), and Lightware Scout ($2995; 5 pounds). If you are looking for a top-of-the-line projector that will project well in large conference rooms, then the Epson PowerLite 7500C should be your choice, but it costs much more ($10,000; 10 pounds).

If you carry your own projector, you should also bring your own extension cord because you may not know how far the power supply will be from the conference table. It is also a good idea to back up your presentation on floppy disks, should your computer happen to malfunction. To be absolutely prepared against technical disaster, you might even take a hard copy of your presentation with you.

Armed with your new projector and our few survival tips, you can now look forward to dazzling your audience when presenting your latest laboratory findings. Links to the product reviews of the projectors listed here are available on our web site at http://mednav.com/features/Science/.

—RICHARD PETERS AND ROBERT SIKORSKI

References

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2. ———, **285**, 1228 (1999).

TECHSIGHTING
BIOMEDICINE

Cell Surgery

If I ask you what is the first thing that comes to mind when you hear the word "transplant," you might think of procedures that transfer a donor heart, some bone marrow, or a kidney. Indeed, the human transplantation field usually involves solid organs and bone marrow cells. Solid organs like the heart are amenable to surgical procedures that have been honed over the years. To this add powerful new immunosuppressants, and you have a viable cure for many diseases. But what do you do with organs that are out of reach of the surgeon's scalpel? How does a surgeon replace muscles, for example?

A group of diseases, collectively referred to as muscular dystrophies, perturbs muscle function. One of them, Duchenne's muscular dystrophy, has been studied extensively. Its gene has been cloned to create an animal model, mdx mouse. This mouse serves as a good experimental system for testing new muscular dystrophy treatments. Some provocative research data became available in 1998: A group of researchers (*1*) showed that bone marrow progenitor cells could actually differentiate into muscle cells in vivo. With this background, a team from Boston (*2*) set out to develop cellular transplantation methods for muscular dystrophy.

First, they designed transplantation experiments to test whether bone marrow progenitor cell populations could be used to restore wild-type muscle fibers in the mdx mouse model. Because the mdx strain has greatly diminished levels of the protein dystrophin, the dystrophin expression in situ was an indication of successful engraftment. In the first experiment, they purified hematopoietic stem cells from the bone marrow of normal male C57BL/10 mice by fluorescence-activated cell sorting (FACS). Cell staining with various markers showed this population (termed SP cells) to be positive for Sca-1, c-Kit, CD43, and CD45, but negative for CD34. These SP cells (2000 to 5000) were injected into the tail veins of lethally irradiated, female mdx mice. After 5, 8, and 12 weeks, the mice were killed and examined by fluorescence in situ hybridization for Y chromosomal DNA, a donor cell marker.

In the bone marrow of the recipient mice, they found the expected populations of cells, all of which were male-derived. They then looked at the tibialis anterior muscle and catalogued dystrophin expression and male nuclei. They found clear evidence of muscle cell engraftment that was of male (donor) origin. For example, at 12 weeks after transplant, up to 4% of the myofibrils were dystrophin positive and had evidence of donor nuclei.

Next, they asked a rather bold question: could muscle cell progenitors be purified directly from muscle using the same methods used to purify bone marrow progenitors? Put another way, could FACS with the use of Hoechst 33342 staining be used to isolate cells that generate adult muscle fibers? Using the Hoechst/FACS method they set out to purify populations of cells from a mononuclear preparation derived from 3- to 5-week-old mouse skeletal muscles. Just as in the standard bone marrow purification experiments, they found a side population (also termed SP) that had the properties of stem cell populations. For example, treatment with the drug verapamil abolished Hoechst staining, as happens with bonafide bone marrow stem cells. But the muscle cells were not identical to bone marrow precursors; the muscle cells were not c-Kit and CD45 positive.

To test for the ability of the muscle SP cells to engraft in adult bone marrow and muscle fibers in vivo, the group prepared muscle SP cells from wild-type adult male mice and injected them into the tail veins of mdx female mice. They injected 7,000 to 20,000 SP muscle cells into five lethally irradiated mdx mice. After 30 days, the mice were killed and four animals were examined. The recipient bone marrow showed between 30 to 90% donor cells, which indicates that muscle cells contain a pluripotent stem cell capable of forming cells of the hematopoietic lineage. They also showed that variable levels of donor cells contributed to the muscle mass. Between 3 and 9% of the recipient's myoblast nuclei were positive for the Y chromosome. In summary, mouse muscle tissue contains a cell population that can be purified and used to generate both functional bone marrow and skeletal muscle in vivo.

Taken together, these groundbreaking studies show remarkable results. As with other tissues like the brain, muscle cell progenitors are pluripotent. The authors hint that SP-like cells can be found in a number of different tissues as well. The engraftment of muscle tissue from a suspension of donor cells has been shown, which opens the door for new approaches to treatment of organ failure besides transplantation. I suspect that experiments with cardiac muscle progenitors cannot be far from complete. Perhaps cardiac surgeons should brush up on their cell biology skills in anticipation.

— ROBERT SIKORSKI AND RICHARD PETERS

References

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2. E. Gussoni *et al.*, *Nature* **401**, 390 (1999).