

Greenhouses grow better students, biologists say

By Laura Kriho

The wind howls, the snow blows horizontally, an arctic blast of ice crystals hits your face and your eyeballs are frozen. But if you are an ecology and evolutionary biology (EBIO) student at the University of Colorado Boulder, you may be lucky enough to have a class that offers a refuge from this winter torment, one that transports you from a bitterly cold Colorado day to a warm desert climate or even to a tropical rainforest.

In this oasis on campus, you can make cutting-edge scientific advances, while surrounded by tropical plants in a tranquil setting, where the only sounds you hear are the soft whirring of fans, the rustling of leaves and the occasional gentle drips of water.

Welcome to the EBIO greenhouses. Faculty and students are fortunate to have these world-class resources on campus, allowing them to conduct research and teaching that would otherwise be impossible.

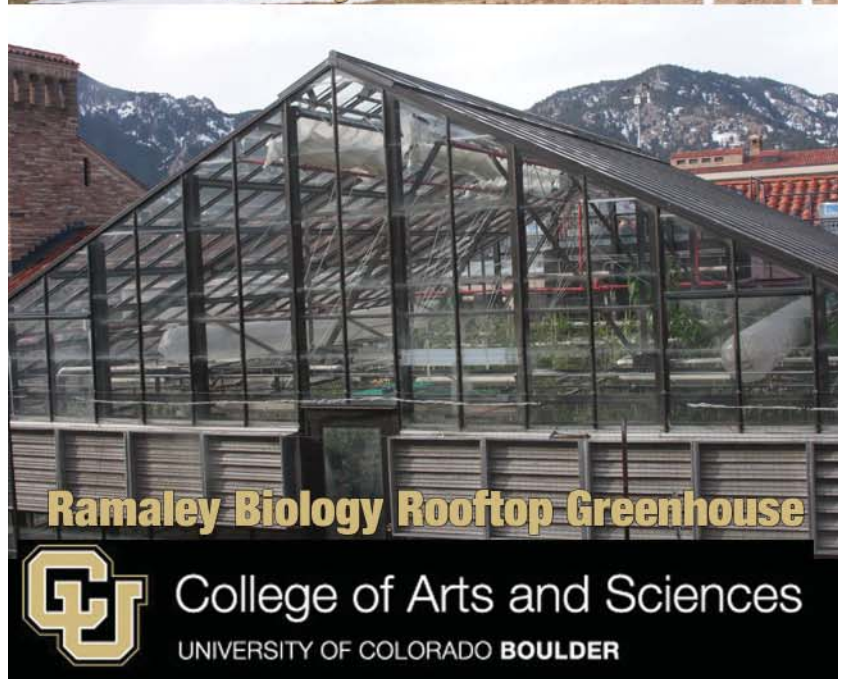
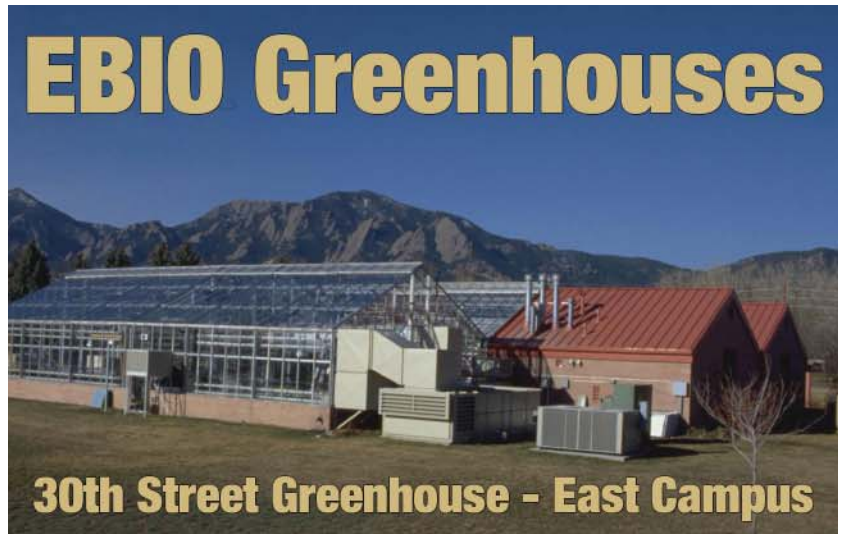
The EBIO plant-cultivation facilities comprise four greenhouses at three campus locations:

- Two ground-level, separate greenhouses near Macky Auditorium, used mainly for teaching.
- A single-room facility on the rooftop of the Ramaley Biology building, used mainly for research.
- The largest facility: a ground-level, compartmentalized greenhouse at 30th Street on East Campus used for both teaching and research.

These greenhouses are home to a wide variety of floras that has been collected worldwide. According to Tom Lemieux, the CU-Boulder greenhouse manager, all of the plants grown in the greenhouses are members of major ecosystems found across the globe, and many are not accessible in the wild due to geographic, language or political barriers.

“Undergraduate and graduate students learn firsthand knowledge about plant diversity, plant anatomy, morphology, evolutionary relationships, plant-animal interactions, pollination biology and other aspects of plant biology utilizing the collections maintained in the EBIO greenhouses,” Lemieux explains.

Plant geneticist Nolan Kane, an assistant professor in EBIO, uses the greenhouse to grow a diverse collection of plants, from sunflowers to chocolate. Kane says the greenhouses provide an opportunity for his students to gain direct experience in genetic sequencing and make unique contributions to plant science.



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Nolan Kane examines a plant in the tomato family, primarily researched by Stacey Smith, in the Ramaley Biology building rooftop greenhouse.

Students in Kane's undergraduate Genomics class use plants grown in the greenhouse on the roof of Ramaley Biology. Over the course of a semester, students are each given a plant species and taught to sequence the chloroplast genome of the plant, which consists of 140,000 to 160,000 bases of DNA. The bases occur in pairs of guanine-cytosine and adenine-thymine.

"Our research would simply not be possible without having well-maintained greenhouses on campus," Smith continues. "Many of our experiments require fresh flower or leaf tissue, so this sort of work can only be done when the plants are grown on campus," she explains.

Margaret Mitter McCormick, a PhD Student in the Mitton Lab at EBIO, says the greenhouses are also instrumental in her research. She studies adaptation to elevation in a small succulent plant called yellow stone crop (*Sedum lanceolatum*). She uses the greenhouses to develop methods of cultivating cuttings and transplants from various elevations.

"It would be much more difficult to cultivate plants from high elevation without CU's greenhouse facilities," McCormick says. "The Alpine Room at the 30th Street greenhouse provides an ideal place to work with high elevation specimens that would likely do very poorly in typical greenhouse conditions in Boulder."

Smith believes that the opportunity for undergraduates to work in these greenhouse facilities not only fosters a better education for the students, but inspires many to continue their studies in the field of plant biology. "Students love the opportunity to experience living plant diversity, and often end up deciding to take their interest in plants beyond the classroom," she says.

Kane thinks that his students definitely get more out of his classes because they are "not just based on a textbook and not just based on a canned example."

"For our students, this is a direct connection to the living, natural world – a connection too often lost or forgotten in today's urban, electronic environment."

"It's a great way for them to learn cutting-edge approaches to genome assembly, sequencing and annotation, figuring out where the genes are in the genome and what they are doing," says Kane.

Once the student finishes the genome and it has been verified, it is published in the chloroplast database of the National Center for Biotechnology Information, making the new sequence freely available to scientists around the world.

"It's really valuable for students to put on their CV that they have done something that no one has ever done before," Kane observes. "They love being able to generate these new resources. They can say 'I made this thing.' It helps them build their skills and their record in a way that I haven't seen in any other public institution."

Stacey Smith, another assistant professor in EBIO, studies the evolution of floral diversity, primarily in the tomato family. Smith finds the greenhouses invaluable in her work. "The greenhouses are essentially living libraries of plants. We use these living collections to study how plants develop, how they respond to their environment and how they reproduce," she says.



Tom Lemieux, manager of the EBIO greenhouses

Lemieux concurs, "Just as in any branch of science education, the most complete, experiential learning takes place when students have access to all avenues of exposure."

For more information or to make a donation, see: <http://www.colorado.edu/ebio/greenhouse/>