HASWELL LAB: Kelsey Kropp

Kelsey Kropp joined the Haswell Lab in September 2013 after finishing her master’s degree in molecular biology at Southern Illinois University in Edwardsville. She is currently working on a NASA grant, researching gravitropism, or directional growth in response to gravity.

Kelsey runs a variety of plant experiments. She works with several gravitropic mutants, one of which contains enlarged plastids. Plastids are specialized plant organelles that contain starch, making them heavy. As a result, these sediment in the direction of gravity, signaling to the plant which way is down. In one experiment, she turns the plants on their sides to study the role plastids play in the gravity response. Differences in the gravity response between shoots and roots cause shoots to grow upwards and roots to grown down. Other experiments look at the plant’s reaction to being turned completely upside down for a couple of days. Some re-orient to grow back upwards, while others don’t respond at all. Some mutants respond to gravity faster than wild type and others more slowly. Those that don’t respond to gravity at all are called agravitropic. The research aims to reveal if and how mechanosensitive (MS) ion channels contribute to gravitropism and mechanoperception. Kelsey is working on building a body of knowledge through activities such as investigating the role MS ion channels play in gravitropism, generating and characterizing new gravitropic mutant lines, and studying different mutants at a macro and microscopic level.

How plants respond to gravity is a fundamental biological question with important implications for growth in space. The Haswell lab is conducting ground-based research designed to lead to space flight experiments. MS ion channels have been proposed to play a role in the perception of gravity in plants for many years—a hypothesis that is supported by several lines of evidence, but one that has not yet been systematically tested by molecular genetics. The lab aims to —cont’d on page 3
GOODENOUGH LAB

Ursula Goodenough’s Lab has been researching algae for more than 40 years. Current lab members include principal investigator and professor Ursula Goodenough, postdoc Taylor Weiss, Lab Tech Tuya Wulan, Lab Manager Carrie Goodson, Staff Scientist Jeanette Rusch, and some undergraduate students through Bio 500 independent study and work study programs.

The lab’s research applies to a vast array of scientific fields including evolution and algal biofuel, as a potential alternative fuel resource. The research team has long used algal growth chambers to study the molecular basis and evolution of life-cycle transitions in the flagellated green alga, Chlamydomonas reinhardtii. The Goodenough Lab’s more recent algal biofuel research is one of three major alternative energy research activities at Wash U. The Blankenship Lab’s research program is centered on the solar energy storage processes that take place in photosynthetic organisms. The Pakrasi Lab studies how cyanobacteria use solar energy to drive the chemistry of life.

Currently, the Goodenough Lab is studying the production of algal lipids for biofuels and the interplay with algal cell walls, driving factors in the most critical problems associated with energy balance and the economic costs associated with biofuels. Some of the algal strains currently under research have robust cell walls, making cells hardy for industrial cultivation, but also difficult for lipid extractions. By understanding the make-up of the wall, the team is exploring making the walls tough during cultivation, but weak during extraction. Conversely, the team is also cultivating a hot, acid extremophile that has no cell wall. While this makes extraction easy, the cells are not rich in biofuel lipids. In this case, the team is exploring increasing salt stress, which increases lipid production. In this way, the team is exploring the biology defining these two extreme scenarios and how to possibly mix and match features to maximize lipid production. A third alga studied represents a possible middle ground. It produces large amounts of lipid, which is good for biofuel production, and then stores them outside the cell in a colonial matrix, which is good for simple extractions; however, this comes at the biological cost of slow growth. Exploring this alga may reveal the biological costs associated with optimizing lipid production and extractability, but also demonstrates a variety of ways to approach and solve the problem.

To learn more about the Goodenough Lab’s research, visit the website: http://biology4.wustl.edu/faculty/ursula/.

—cont’d on page 3
Haswell Lab cont’d — determine the role played by MS ion channels in mediating gravity signal transduction, their putative roles in adaptation to microgravity, and the molecular mechanisms by which the model MS ion channel MSL10 activates stress-response pathways in plant cells.

Lazy Experiment: Images of wild-type (Col) and Arabidopsis gravity mutant after being inverted for 2 days. Arrow indicates direction of gravity vector.

The results of Kelsey’s research at the Haswell Lab could elucidate how plants respond to environments with altered gravity and be applied to plants in space colonies in the future as potential sources of food. In addition, plants have also been implicated in mood improvement for humans, i.e. astronauts can mentally/emotionally benefit from having plants around.

Stay tuned to the Haswell Lab website for the results of new experiments! http://pages.wustl.edu/haswell

Starch Staining: DIC images of Arabidopsis wild-type (Col) and gravity mutant roots stained with Lugol’s iodine.

Shoot Gravitropism: Wild-type (Col) and gravity mutants of Arabidopsis thaliana plants subjected to horizontal gravistimulation at 23 (degrees) C. Image captured after 180 minutes.

Goodenough Lab cont’d— On a personal note, Ursula’s sixth grandchild, Luciano Goodenough Sanseverino, was born on December 6 on Martha’s Vineyard!
Tyson Research Center is a 2000 acre natural site near Eureka, MO, only 30 minutes from the Danforth Campus. The property was obtained by Wash U as surplus property from the federal government in 1963. Tyson’s mission is to provide a living landscape for environmental research and education as a component of Washington University’s initiatives in environmental studies and sustainability, including the International Center for Advanced Renewable Energy and Sustainability (I-CARES). Tyson provides a living landscape of local habitats for environmental research and education, with a particular focus on providing high-level research opportunities for Washington University undergraduates in the environmental sciences.

Although open to a wide-variety of research projects that require open spaces, core research activities at Tyson and surrounding natural areas focuses on integrating basic scientific approaches with applied problems that result from the ever increasing footprint of human activities on the planet. The primary research focus is on ecosystem degradation, restoration, and sustainability as part of Washington University’s International Center for Advanced Renewable Energy and Sustainability (I-CARES).

Under the auspices of I-CARES, sustainability research at Tyson focuses on a variety of interrelated problems in environmental science. Large-scale multi-investigator projects focus on the maintenance and restoration of biodiversity and ecosystem services in the context of habitat loss and mitigation, alteration of disturbance regimes, invasive species, and global climate change. Examples of specific research foci include:

—Impacts of invasive species on community and ecosystem functions, and the success of different control strategies

—The role of urbanization, agriculture, and other habitat degradations on wetland biodiversity and ecosystem functions.

—Responses of biodiversity and species composition to global climate change.

—The ecology of emerging infectious diseases in human-altered landscapes: Effects on pathogen vectors (mosquitoes and ticks) and hosts

—Effects of urbanization on hydrology and biogeochemistry

Other research projects at Tyson include studies on other aspects of environmental biology (evolution, population genetics), sustainable architecture and energy, archaeology, geology, hydrology, crop production and biotechnology, and biomass production for biofuels.

Key researchers at Tyson from the Biology Department include Tiffany Knight, Stephen Blake (also faculty at UMSL) and new Biology faculty members Scott Mangan and Jonathan Myers. A full list of researchers, postdocs and grad students can be found on the website. Undergraduate work is also an important part of the work that goes on at Tyson. Undergrads work with Wash U faculty mentors and can also be paired with mentors from other local universities that have projects going on at Tyson during the summer.

Currently, there are three large-scale National Science Foundation funded projects based on research done at Tyson including: Glade Restoration; Phylogenetic Novelty and Species Invasion; and Aquatic Biodiversity and Invasive Species. In addition to those environmental research projects, an Institute for School Partnership outreach grant involving both Tyson and Shaw Nature Reserve aims for quality over quantity through educational programming targeting local high school students. These students are paired with undergrad mentors from Wash U, giving the high school students an authentic research experience. This high level experience has led some students to eventually enroll at Wash U after project completion.

In addition to project and research grants there is a facilities improvement grant underway. As research expands and diversifies at Tyson, a need has arisen to pair Tyson’s large scale ecological field experiments with —cont’d on next page
more controlled experimentation. Construction will begin soon on a research garden that will allow PIs to experiment in a natural environment that can be easily manipulated in a way that is multi-functional and flexible. It’s like a greenhouse without the “house”. In other words, it will not be an artificial environment but will have structures in place to give PIs the flexibility to control the natural environment. Irrigation systems and basic framework for moveable shades or panels will allow researchers to run competition experiments with plants, drought manipulations or soil modifications, pollinator manipulations, and more. The garden will use rainwater runoff from the roof for irrigation.

Other recent improvements include the renovation of Tyson’s headquarters building and a brand new laboratory facility built into the existing warehouse structure that was part of the original army base which was located on the site before it became Tyson Research Center. The headquarters building was reconfigured and updated to include more efficient office and conference space for postdocs, grads and PIs. The new laboratory facility includes wet labs, a microscope room, tank rooms and other spaces for experiments. The communal research facility will be open this fall. PIs will share the space based on the function they need, rather than have their own separate labs. The building was designed to be easily expanded in the future as necessary. In addition, new solar panels are currently being installed to provide power for both the headquarters and lab buildings on site. Future additions could include molecular and geochemistry labs, depending on the future needs of researchers. There are also plans for the future addition of on-site housing to allow more in-depth projects and places to stay for visiting researchers and undergrads working on summer projects.

A site as large and diverse as Tyson provides many educational opportunities, including field trips, the summer undergraduate research program, and entire courses taught on site. Though most research and education at Tyson is based at Wash U, other local universities also use the site for research and teaching in ecology, botany, and related subjects. Regular Wash U Biology courses at Tyson include a variety of freshman seminars, Bio 393 and Bio 4193. Bio 393: Practical Skills in Environmental Biology Research is taught mainly on the Danforth campus with field trips to Tyson. This spring course is considered to be a fast track path to doing summer research on site. Bio 4193: Experimental Ecology Lab is taught completely on site using the classroom at the Living Learning Center as well as the natural environment. This course, formerly taught in fall semesters, will now be offered in spring beginning in 2014, and will be taught by Scott Mangan. Other departments at Wash U including Environmental Engineering, —cont’d on next page

Interior shots of the newly completed laboratory facility adjacent to the Tyson Headquarters building

Below: CORE 10 Architecture rendering of proposed research garden
Tyson cont’d—Earth and Planetary Sciences, and even Design and Visual Arts use the site for teaching purposes as well. Tyson is not open to the public and is not a recreational area like its neighbor Castlewood State Park on the Meramec River. People who are not currently conducting research at Tyson but want to visit can attend special events and weekly Ecology Seminars during summer. Visit the website at http://tyson.wustl.edu/index.php for more information on the events, people, research and facilities of Tyson.

New Associate Director for Tyson Research Center, Kim Medley

Kim Medley joined the Tyson Research Center as Associate Director in late September, 2013, following a long hiatus from the Midwestern US. She grew up in Springfield, MO, receiving her master’s degree from Missouri State. She went on to get her PhD at the University of Central Florida in Orlando and completed postdoctoral work at the University of Colorado-Boulder.

Dr. Medley’s PhD thesis, The Role of Human-Aided Movement to the Invasion of an Exotic Mosquito, studied the entire US range of the Asian Tiger mosquito along with modeling exercises to estimate distribution. She combined this work with genetic analyses and common garden experiments to examine the role of natural and human-aided gene flow to climatic adaptation and its contribution to the northward spread of the mosquito in the US.

Dr. Medley’s postdoctoral work studied amphibian abnormalities, more broadly, the role of landscape characteristics and environmental contaminants and explaining patterns of disease. Her research at Tyson integrates research questions that she explored for both her PhD and postdoc topics. Her current research looks at the status of disease for amphibians in this region and the combined role of landscape characteristics and dispersal, both human-aided and natural on disease persistence and spread. The research requires field work at Tyson, and lab space for the molecular component. On top of research, her role at Tyson is largely administrative as well. She manages the day to day operations and larger facilities projects on site. She currently serves as the interim director of Tyson. For more information on how to get involved in the ongoing research at Tyson or to propose your own research project, contact her at Kim.Medley@wustl.edu.

Ridgetop, Tyson Forest Dynamics Plot, Winter 2011, Photo credit: Jonathan A. Meyers
Dear Biology Colleagues,

I am very pleased to announce that Kathy Miller has agreed to extend her appointment as chair for an additional three years, through June 30, 2017. I greatly appreciate Kathy’s willingness to continue serving in this important capacity, and I look forward to the ongoing success and contributions of the department.

With my best wishes,
Barbara A. Schaal
Dean of the Faculty of Arts & Sciences
Mary-Dell Chilton Distinguished Professor

Professor Joan E. Strassmann installed as the Charles Rebstock Professor of Biology on January 23, 2014

Chancellor Mark S. Wrighton and Dean Barbara A. Schaal hosted the installation of Joan Strassmann as the seventh Charles Rebstock Professor of Biology.

Professor Strassmann joined the faculty in the fall of 2011, coming from Rice University. Her PhD advisor at the University of Texas was Alan Templeton, the Charles Rebstock Professor Emeritus of Biology.

Professor Strassmann’s recent research interests focus on cooperative behavior in amoebae and model pseudo-organisms with artificial life cycles.

This professorship was established in 1925 with a gift from Mr. Rebstock, a member of the university’s board of trustees. His gift also enabled the construction of Rebstock Hall, which was constructed to expand the study of biology and completed in 1927.

Debbie Brock featured in National Geographic magazine article

In 2011, a team of scientists including postdoc Debbie Brock, now at Washington University in St Louis, discovered that Dicty is also a farmer. Many of the amoebas carry edible bacteria inside them. When they land in a new spot, they seed their environment with this livestock, starting their new lives with a ready supply of food… Read more at: http://phenomena.nationalgeographic.com/2013/07/29/how-the-worlds-smallest-farmers-turned-chemists-into-food/

Tyson designated an Earth Observatory: Forest plot named long-term monitoring site in the Smithsonian Institution’s global forest network

—by Diana Lutz, Read more in The Record: https://news.wustl.edu/news/Pages/26185.aspx

Light filters through the canopy at WUSTL’s Tyson Research Center at dawn. The forest, just designated a ForestGEO, will become part of an early warning system for the effects of climate change on the biosphere. Photo credit: Jonathan A. Myers
Scientists stitch up photosynthetic megacomplex: Scientists able to study a photosynthetic complex — arguably the most important bit of organic chemistry on the planet — in its complete functioning state — by Diana Lutz

Robert Blankenship, PhD, PARC’s director and the Lucille P. Markey Distinguished Professor of Arts & Sciences, said that one outcome of the work in the long term might be the ability to double or triple the efficiency of crop plants — now stuck at a woeful 1 to 3 percent. “We will need such a boost to feed the 9 or 10 billion people predicted to be alive by 2050,” he said.

The photosynthetic megacomplex from a cyanobacterium, which scientists have managed to isolate in its complete, functioning form, weighs about 6 million Daltons. It has three parts: on top is a light-harvesting antenna complex called a phycobilisome that captures and funnels the energy in sunlight to two reaction centers, Photosystem II (the complex protruding beneath the antenna) and Photosystem I (the complexes to either side of Photosystem II). The megacomplex is embedded in a membrane shown as a green carpet.

...“PARC is one of the only places in the world that has available this sophisticated combination of experience and advanced techniques,” said Blankenship, “and to solve this problem, we brought all of our expertise to bear.

“The work provides a new level of understanding of the organization of these photosynthetic membranes, and that is something that a lot of people have tried to understand for a long time,” he said. Read more in The Record: https://news.wustl.edu/news/Pages/26091.aspx

Elizabeth Atkinson’s baboon research presentation at the Society for Neuroscience Conference featured in public media online

Baboons Shed Light on Human Brain Evolution

Research with baboon brains has provided new insight into the evolution of the human brain, a new study contends.

The genetics behind the development of folds in the human brain have been a mystery, but there are new clues in a study scheduled for presentation Sunday at the annual meeting of the Society for Neuroscience, in San Diego.

As the human brain evolved, there was a dramatic increase in the number of brain cells and connections, the researchers said. But this growth was restricted by the size of the skull in relation to the birth canal, leading the brain to fold into ridges and valleys.

“The evolution of the human brain over time is a very complex process,” Elizabeth Atkinson, of Washington University in St. Louis, said in a Society for Neuroscience news release. “Our study connects the folding of the brain with the underlying genetics, and provides unique insight into how the evolution of our genes has driven the shape, and ultimately the function, of our brains.”—Read more: http://consumer.healthday.com/cognitive-and-neurological-health-information-26/brain-health-news-80/baboons-shed-light-on-human-brain-evolution-study-says-681857.html

Hamadryas Baboon (Papio hamadryas) - photo by André Karwath / Wikimedia Commons
ISP to Host Darwin Day

In an effort to support the teaching of evolution in K-12 schools, the Institute for School Partnership hosts an annual celebration of Charles Darwin’s birthday in early February.

Friday, February 7
4:30 to 5:30 pm
Informal presentation for teachers and high school students

Renowned evolutionary biologist Dr. Sean B. Carroll, Howard Hughes Medical Institute vice president for science education; Allan Wilson Professor of Molecular Biology, Genetics, and Medical Genetics at the University of Wisconsin–Madison

“Evo Devo and an Expanding Evolutionary Synthesis”

Evo devo, which is shorthand for evolutionary developmental biology, deals with two complementary issues: (1) how developmental processes have evolved over time in different lineages of animals and plants, and (2) the role that such changes in embryonic development have played in producing the phenotypic variation that has been acted upon by natural selection. This is a relatively new branch of evolutionary biology, and Sean Carroll is widely considered to be one of the world’s most productive evo devo investigators.

All teachers are welcome and high school teachers are asked to encourage their students to attend. Please register for this event.

Saturday, February 8
8:30 am to 12:00 noon
Evolution education event for teachers

“Science Education and Storytelling: The Making of a Theory”

How can we help students appreciate and understand the history of life — and what we know and how we know it? Film is one potentially powerful medium for bringing the excitement of scientific discovery into

--- Cont’d on next page ---
She became a full professor at Washington University in 1958, then established a research center in Rome, and for some years divided her time between St. Louis and Rome. In her autobiography, In Praise of Imperfection: My Life and Work, Levi-Montalcini described her years at Washington University as “the happiest and most productive years of my life.” — Read More in The Record: http://news.wustl.edu/news/Pages/25948.aspx

Members of the Washington University in St. Louis community gathered on 10/15/13 to remember Rita Levi-Montalcini, one of two women from the university who won the Nobel Prize. The event was hosted by the Woman’s Club of Washington University.

Levi-Montalcini discovered nerve growth factor, a cellular “factor” that the body uses to direct the growth of nerve networks. In 1986, she shared the Nobel Prize in physiology or medicine with biochemist Stanley Cohen, PhD, also of Washington University, who helped her identify the factor. Her work is still in the news. On Oct. 2, scientists at the University of Oregon reported that the level of nerve growth factor in spit varies with responses to stress and predicts long-term psychological health.

As an Italian Jew, Levi-Montalcini had the misfortune to begin her career in the 1930s. Forced to leave the University of Turin when Mussolini came to power, she continued her research in a laboratory she set up in her bedroom in Turin. Viktor Hamburger, then chair of the zoology department at Washington University, was working in St. Louis on the same research problem as Levi-Montalcini. In 1946, he invited her to St. Louis to see if they couldn’t reconcile their disparate findings.

Darwin Day cont’d—the classroom, and for illustrating the scientific process. HHMI has launched a science filmmaking unit to produce films for science classrooms, as well as for broadcast and giant screens. This film tells the story of the epic voyages and revolutionary insights of two brave young British naturalists, Charles Darwin and Alfred Russel Wallace. Prodigious collectors of animals and plants, each man developed a keen appreciation for the diversity of species, the variation within species, and the geographic distribution of creatures around the world. From this very hard-earned knowledge, they asked not just what creatures existed in a given place, but how they came to be? The pursuit of that question led Darwin and Wallace to the independent discovery of the natural origin of species, and to the theory of evolution by natural selection.

Special prizes will be awarded to the elementary, middle, and high school with the most teachers in attendance!

All teachers are welcome. Please register for this event. See website for detailed schedule: http://schoolpartnership.wustl.edu/programs-services/evolution-education/darwin-day/
Welcome to “Safety Spotlight”.

Thankfully, we have no recent chemical spills or laboratory fires to write about.

The most significant changes in 2013, from a laboratory safety viewpoint, were the adoption of new hazardous waste management regulations in July under the Environmental Protection Agency (E.P.A.) laboratory rule known as “Subpart K”, and, in October, the transition from “Haztrak” to an institution-wide “Chemical Inventory System” (C.I.S.), affecting how chemical containers are being tracked from point of purchase to disposal.

The “Subpart K” ruling represents an easing of previous hazardous waste regulations for academic laboratory operations specifically, as the result of a rather lengthy, costly, and *one-time-only* negotiation process between the E.P.A. and a group of higher learning institutions, including Washington University.

This process was initiated by a set of “Notice of Violation” (N.O.V.) issuances in the spring of 2008 at both the Medical and Danforth campuses. The resulting applicable (and sizable) fines that are the customary impetus for the violator(s) to become compliant were reduced significantly as part of the “Subpart K” ruling.

As a consequence of this mutual agreement between the E.P.A. and Washington University, any N.O.V. issued by the E.P.A. after July of last year is no longer subject to being negotiated, but will rather have to be paid in full. It is within this context that compliance with the new rules under “Subpart K” is especially precious. Here is another look at the main differences between what used to be “Hazardous Waste” and the new “Unwanted Materials” regulations: SEE NEXT PAGE.

For more information, please consult http://ehs.wustl.edu/HMM/Pages/default.aspx#subpartk.

Saying good-bye to “Haztrak” may not have been easy for some; we are all getting more used to the C.I.S., which carries the promise of allowing the University the kind of reporting capabilities that are or will be required by various outside regulatory agencies, but could not be achieved with the “Haztrak” system. As is the case now, the vast majority of C.I.S. users will need to know how to:

~ Transfer a container from the stockroom to one of their laboratory locations

~ Delete their lab’s inventory in periodic intervals to keep up with emptied containers

Both tasks have recently been made easier by a programming change that now allows the C.I.S. to display both, the inventory number (assigned to chemical containers after 04 Oct 2013), and the barcode number (assigned to chemical containers before 04 Oct 2013). For C.I.S. tutorials, a test drive, or guidelines, please consult https://ehsaweb.wusm.wustl.edu/login.asp

Continue to be safe — and remember: “Falling objects can be brutal if you don’t protect your noodle”.

Do you have any exciting news to share? Please submit announcements, lab notes and photos to Erin Gerrity: gerrity@biology2.wustl.edu
<table>
<thead>
<tr>
<th>Chemical Disposal Guidelines</th>
<th>Before July 1, 2013</th>
<th>After July 1, 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labeling</strong></td>
<td>Hazardous Waste label on yellow background</td>
<td>Unwanted Material label on blue background</td>
</tr>
<tr>
<td><strong>Must be removed within</strong></td>
<td>One year</td>
<td>Six months</td>
</tr>
<tr>
<td><strong>Maximum accumulation volume in lab</strong></td>
<td>55 gallons of hazardous waste</td>
<td>55 gallons of unwanted material</td>
</tr>
<tr>
<td><strong>Time for removal from labs by EH&amp;S</strong></td>
<td>Total of 1 quart of 124 P-listed acute hazardous wastes</td>
<td>Total of 1 quart of 6 P-listed reactive acutely hazardous unwanted materials</td>
</tr>
<tr>
<td><strong>Labeling requirements in labs</strong></td>
<td>3 calendar days after request for pickup is made to EH&amp;S</td>
<td>10 calendar days after request for pickup is made to EH&amp;S</td>
</tr>
<tr>
<td><strong>Container management</strong></td>
<td>“Hazardous waste”</td>
<td>“Unwanted material”</td>
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<tr>
<td></td>
<td>Information re: contents of the container including concentrations</td>
<td>Information re: contents of the container, including concentrations</td>
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<td></td>
<td>Sufficient information to make a hazardous waste determination, and</td>
<td>Sufficient information to make a hazardous waste determination, and</td>
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<td></td>
<td>Accumulation start date</td>
<td>Accumulation start date</td>
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<tr>
<td><strong>Acutely hazardous waste</strong></td>
<td>Containers must be in good condition</td>
<td>Containers must be in good condition</td>
</tr>
<tr>
<td><strong>Must be removed from lab within 6 months or 1 quart limit is reached</strong></td>
<td>Contents must be compatible with container</td>
<td>Contents must be compatible with container</td>
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<tr>
<td></td>
<td>Containers must be kept closed except:</td>
<td>Containers must be kept closed except:</td>
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<tr>
<td></td>
<td>When adding or removing waste</td>
<td>When adding, removing, or consolidating unwanted materials</td>
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<td>Working containers may remain open until the end of shift or procedure, whichever is first (no more than 2 gallon containers in secondary containment)</td>
<td>Working containers may remain open until the end of shift or procedure, whichever is first (no more than 2 gallon containers in secondary containment)</td>
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<td></td>
<td>When venting is necessary</td>
<td>When venting is necessary</td>
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<tr>
<td><strong>Laboratory clean-outs</strong></td>
<td>Any of 124 P-listed acute hazardous waste codes apply</td>
<td>Only 6 P-listed acute hazardous waste codes apply:</td>
</tr>
<tr>
<td></td>
<td>P006 = Aluminum Phosphide</td>
<td>P006 = Aluminum Phosphide</td>
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<td></td>
<td>P009 = Ammonium Picrate</td>
<td>P009 = Ammonium Picrate</td>
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<tr>
<td></td>
<td>P065 = Mercury Fulminate</td>
<td>P065 = Mercury Fulminate</td>
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<tr>
<td></td>
<td>P081 = Nitroglycerin</td>
<td>P081 = Nitroglycerin</td>
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<tr>
<td></td>
<td>P112 = Tetranitromethane</td>
<td>P112 = Tetranitromethane</td>
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<td></td>
<td>P122 = Zinc Phosphide &gt;10%</td>
<td>P122 = Zinc Phosphide &gt;10%</td>
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<tr>
<td></td>
<td>Chemicals must be removed from laboratories in 3 days from time Request for Pickup is submitted</td>
<td>EH&amp;S has 30 days to conduct a clean-out</td>
</tr>
</tbody>
</table>