Biocompare

The Buyer's Guide for Life Scientists

Expert Guide to Setting Up a New Lab

Sponsored by

NUAIRE

Contents

THE SAFER CHOICE FOR YOUR LABORATORY

BIOSAFETY CABINETS. HORIZONTAL AND VERTICAL LAMINAR AIRFLOW WORKSTATIONS. CO2 INCUBATORS. ULTRALOW FREEZERS. CENTRIFUGES. CUSTOM SOLUTIONS.

Laboratory Equipment by NuAire.

www.nuaire.com

New Lab Know-How

All research areas are unique, but some general set-up tips help everyone.

Mike May

Lab space and some startup funds might look like a pot of gold at the end of a rainbow, but it's just the start. Sure, it took a lot to get there—a new position and a lab to arrange—but that empty space and a fixed budget indicate more to do. A new lab needs a collection of equipment, such as a centrifuge and a safety hood, plus a freezer and an incubator, and more. The list of things to buy, arrange, and get working can seem daunting. So, consider the following expert tips to make the process easier and more efficient—all aimed at creating the most effective lab space.

The outcome in setting up a new lab depends on a good start. "Identify what kind of work is going to be done in the lab," says Scott Christensen, vice president of business development at NuAire. "Then, identify the kind of infrastructure that will be needed to support that work."

In a life science laboratory, for example, a scientist might need a class II biological safety cabinet (BSC), an incubator, an ultralow-temperature freezer, and so on. Anyone working with chemicals or solvents will also need a fume hood. Some of these devices—especially a hood and a BSC—provide personnel and sample protection. Deciding on the level of protection that will be required will depend on the work. As Christensen emphasizes, "First, figure out what direction of research you will take."

Taking inventory

Setting up a new lab is quite a task, which is why it's important to have an organized approach. "Take a look at the space where you're setting up shop, and see what is already there that you can use," Christensen suggests. "If there's some existing equipment that you can make use of, then you can use your funding—from your institution or grants—to purchase equipment that you really need."

To decide what can be used and what can't, Christensen suggests consulting a lab manager. "They can be a good source of various kinds of information," he says. He adds that it helps to "deal with someone familiar with capital equipment—not someone just looking in catalogs—who can give you the right advice on selecting equipment" and that "it's different than ordering media and other consumables, like plasticware."

If there's not someone in the department or institution to help, scientists can call a supplier. For example, Christensen says, "NuAire sales reps have a wealth of experience," and they are just a call away.

Ultimately, as Christensen points out, a scientist setting up a new lab has two choices: "Educate yourself or consult someone."

Mistakes to avoid

Some of the most common mistakes in setting up a new lab come from not gathering enough information. With a large piece of equipment, the key question is this: Will it fit? Not just that, but will it fit in the intended spot? That might depend on a lab's ceiling height, bench space, and so on.

Once it's clear that a piece of equipment will fit in a desired location, a scientist needs to make sure that it's possible to get the piece to that spot. "You need the logistics of getting from the loading dock to the lab," Christensen says. "Is there an elevator?" If there's not and the equipment is big, it might stay on the loading dock.

"That's why you should consult with someone who has done it before and have them help size up your needs," Christensen explains. If all else fails in the size-up stage, get a tape measure and measure twice or more.

Christensen sees other challenges in size that scientists run into in setting up a new lab. One is the size of a BSC. "We sell lots of four-foot cabinets, and sometimes people buy six-foot ones for two people," he says. "How many people will be working in the lab?"

For scientists who can't decide what size BSC to buy, think about asking NuAire. "We can determine if a lab could get away with four- or five-foot cabinets, instead of sixes," Christensen says.

Assessing safety

In selecting the kind of BSC, besides its length, NuAire won't tell a customer which one to use. "You need to take a risk assessment and get advice from a safety person," Christensen says. "They'll tell you if, for instance, an A2 is okay for your application or if you need a B2."

Here, too, the features of a building impact the options. "Some people think that they need an exhausted cabinet," Christensen explains, "but the lab might not have an exhaust connection." In that case, either a connection must be added, which could be expensive, or a ventless option must be selected.

For safe solutions in setting up a new lab, Christensen points out that lots of information is available online. In particular, he mentions the U.S. Centers for Disease Control & Prevention's *Biosafety in Microbiological and Biomedical Laboratories* (BMBL). As the CDC notes, this document "quickly became the cornerstone of biosafety practice and policy in the United States upon first publication in 1984." The organization adds that the "5th edition of the BMBL remains an advisory document recommending best practices for the safe conduct of work in biomedical and clinical laboratories from a biosafety perspective."

Image: When setting up a new lab, scientists should seek information where they can, including online and from colleagues and suppliers. Image from Dreamstime.

So, scientists should seek information where they can in setting up a new lab. "You can educate yourself online," Christensen concludes. "It's a great resource."

About the Author

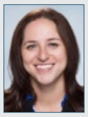
Mike May earned an M.S. in biological engineering from the University of Connecticut and a Ph.D. in neurobiology and behavior from Cornell University.

Lab Setup: Ask the Experts

Three experts weigh in on creating the most efficient working space.

Mike May

Beyond general suggestions for setting up a new lab, nothing helps more than asking people with recent experience. Here, we talked with three scientists from different universities to hear what worked, what didn't, and how to learn from their experiences.



Jillian Goldfarb
Assistant Professor of Biological and Environmental Engineering, Cornell University

Please briefly describe your experience in setting up a new lab.

I've set up three labs, each with the same scope—the production of biofuels and materials from carbonaceous wastes, focused around thermal analysis and characterizations.

What is your approach to setting up a new lab?

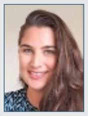
My approach is to maximize return on investment in terms of short-term productivity and the longer-term of what equipment will give me flexibility to move research in new directions. I use start-up funds for large equipment and the peripheral items to commission the equipment. Finding either internal or external awards for small items and supplies has been easier for me than getting equipment grants. I negotiate with vendors, sometimes coupling pieces, and choose end-of-quarter times to buy when I know my sales reps want to boost their numbers.

What is the most challenging aspect of setting up a new lab?

For me, the biggest hurdle is the wait for the lab space to be ready. I had two labs that required renovations. This puts you on the facility's timelines; securing approval from the university and making sure local building codes are met can take time. This also means having an idea of your equipment requirements—venting, power, space, etcetera—before you order everything so the architects can plan accordingly.

Do you have any tips for purchasing and setting up specific pieces of equipment?

Size things for bigger capacity than you can currently envision. For things like fume hoods, for example, you may only need one six-foot hood right now, but what about in two years when you have four students vying for space on that one hood? It's better to spend a little more money up front to go bigger than to purchase additional capacity later.



Andrea Gschwend
Assistant Professor of Horticulture and Crop Science, The Ohio State University

Please briefly describe your experience in setting up a new lab.

I started a plant molecular genetics lab in August 2018. This was my first lab setup, and I inherited the lab space from another group, along with some of their equipment and glassware.

What was your approach to setting up a new lab?

I thought about my research questions and the types of projects and experiments my lab would pursue. I looked at the protocols and made note of the equipment, consumables, and chemicals that were required. I also thought back to the equipment I commonly used in my previous labs. I compiled spreadsheets of large or key equipment, such as centrifuges and thermocyclers; smaller lab items, such as glassware and pipettes; consumables, such as microfuge tubes and PCR plates; and chemicals. I requested quotes and ordered items in stages, starting with the large equipment and smaller reusable lab items, then moving to consumables and chemicals.

Do you have any tips for purchasing and setting up specific pieces of equipment?

Talk to the sales representatives if you plan to purchase big-ticket items or multiple items from the same company. They often have discounts or cashback deals for new labs. Also, it was important for me to stay focused on the items my lab needed and not get sidetracked on items my lab wouldn't use or could occasionally borrow from other groups.

Keep in mind that setting up your lab space is just a small part of setting up a research program. The ideas and people you bring in will make it a success.

Patrick Horn
Assistant Professor of Biology,
East Carolina University

Please briefly describe your experience in setting up a new lab.

I started a plant lipid biochemistry–focused academic lab designed for eight to ten researchers at full-capacity ranging from undergraduates to post-docs. This was my first lab setup as the lead investigator, but I had been a part of moving two separate academic labs into new buildings that required start-up-like purchasing.

What is your approach to setting up a new lab?

I attempted to make an exhaustive list of items I thought I would use based on previous experience. Other faculty and staff members helped me identify potential shared equipment to minimize extraneous purchases. Next, I measured every square inch of lab space available and sketched out where I would house each major purchase. I then used my initially empty lab space and pretended I was carrying out some standard experiments to test its efficiency in principle. This visualization was helpful.

What is the most challenging aspect of setting up a new lab?

For me, it was the constant struggle of this question: Am I making the best purchasing decision with all the choices available? So, I made sure I spent considerable time on comparing the larger purchases. On many of the less-expensive items or consumables, I eventually settled on being okay with making a purchasing mistake and that some items will just be better than others.

Do you have any tips for purchasing and setting up specific pieces of equipment?

Physically see an item in person and talk to a researcher experienced with this particular item. One example is that my shaking incubators were 40% larger than I imagined and, therefore, could not be easily stacked. If I would have physically seen the items, I may have made a different decision.

About the Author

Mike May earned an M.S. in biological engineering from the University of Connecticut and a Ph.D. in neurobiology and behavior from Cornell University.

Setting Up Your Cell Culture Space for Success

To be successful, many issues need to be addressed head on.

Lauren Tanabe

There are over one hundred trillion cells in the human body. These tidy parcels collaborate in exquisite synchrony—dividing, differentiating, morphing and stretching, beating, and reaching. Like something akin to magical realism, these tiny building blocks of self-contained life stack on top of each other giving way to an unimaginably complex machine: the human body. And yet, inside of each cell is a vast universe complete with a nuclear sun at its center.

For well over 100 years, scientists have sought to peek inside of these cells, to coax out well-guarded secrets, to unearth the mechanisms that yield life (and death). But how can one understand the cell when it comes attached to an organ within a body?

Cell culture got its start as tissue culture. Scientists lopped off bits of animals and bits of organs and tried their luck at growing them for a few days inside of a dish. The earliest tissue culture consisted of chicken embryos floating in warm saline. This technique was pioneered by an embryologist named Wilhelm Roux in the late 19th century. Others soon followed suit. The 20th century brought a flurry of advances that eventually allowed for cells, not tissue, to be separated and kept alive in a soup of nutrients. The 1940s brought the first mouse lymphocyte cell line; the 1950s brought Eagle's famous media recipe and the establishment of the now controversial HeLa line.

Today, the basic principles remain the same, but the techniques evolve at breakneck speed. Cells now live indefinitely inside of incubators. Stem cells transform into cardiomyocytes that beat in plates, or neurons with long, winding axonal tendrils. Fibroblasts are reprogrammed as stem cells. Forget two dimensions! Cancer cells are grown in three dimensions (or four, if you add the component of time) mimicking tumors in the body. Scientists edge closer and closer to therapeutic frontiers, and the progress is staggering.

Lee Ligon is associate professor and associate department head in the department of biological sciences at Rensselaer Polytechnic Institute. She's worked with cells for nearly 25 years and remembers the excitement cell culture evoked in her early days at the bench. "The first time I actually saw fluorescent mitochondria moving in axons and dendrites—that sounds so tame now, but at the time, it was awe-inspiring!"

These days, her lab works to make biomimetic tissue culture models, especially of the tumor microenvironment. "We have developed ways to co-culture multiple cell types, to use different 3D ECM (extracel-

Reliable. Uniform. Stable.

CONSTANT CONTAMINATION CONTROL. FASTER RECOVERY.

In-VitroCell CO_2 Incubators by NuAire.

NUAIRE

nuaire.com/in-vitrocell

lular matrix) models with varying mechanical properties, and various combinations of these features. We're now working to develop a high(er)-throughput method to look at the biomechanical properties of the tumor microenvironment."

More sophisticated setups, same old scoundrels

Yet, despite the innumerable advances, there are the old foes that plague experiments and hinder findings. These are the microbial saboteurs that boldly set up shop inside of cell culture experiments. These are the ill-trained staff that don't fully grasp aseptic technique, cut corners, or ignore protocol. These, according to scientists and experts, are the things new researchers need to get a handle on if they want to be successful and competitive.

Sokol Todi, associate professor of pharmacology at Wayne State University, stressed how critical it is to train staff properly: "Contamination has always been an issue and will always be an issue. You can have all the bells and whistles, but as soon as you introduce humans into the equation you will have problems. Train your staff yourself and if you are new to cell culture, make sure you find someone who has lots of experience or an online journal and learn from them." Consider reading Geraghty RJ, et al.'s article to get started.[1]

Beware of surprising sources of contamination, too. Fluorescent lights, for example, can photoactivate HEPES buffer, riboflavin, and tryptophan, leading to the production of hydrogen peroxide and free radicals. Sera supplements are a common source of both biological and chemical contamination. For this reason, it is best to stick with a particular source and lot of serum that has been successful in the past.

Melanoma masquerading as breast cancer—Why cell-line validation is a priority

To date, there are 488 cell lines that are cross-contaminated or misidentified. The database documenting these cells is maintained by the International Cell Line Authentication Committee.

One of the most notorious is the MDA-435 (or MDA-MB-435) line. These cells emerged in lab research in 1975. Since then, the cells made appearances in more than 1,000 scientific articles as breast cancer cells. This turned out to be a big problem, however. When scientists examined the DNA of these cells, they were stunned to discover that MDA-435 was a melanoma line, not a breast cancer line.

Journals now require, or strongly encourage, scientists to authenticate their cell lines. A Nature commentary from 2015 called on scientists to be more proactive in this regard, yet acknowledged common obstacles: "If we exclude ignorance and indifference, cost and simplicity of assays appear to be the biggest roadblocks to universal use of cell authentication."[2]

STR (short-tandem repeat) and SNP (single nucleotide polymorphism) analyses represent viable methods for verifying cell-line identity. STR involves analyzing repetitive sequence elements, 3–7 base pairs long, that are scattered throughout the genome. SNPs, which are genetic variations between members of the same species, are conserved within a specific locus and can be used to confirm identity. Commercial kits for SNP assessment are available, whereas scientists can send cells to companies such as Promega or ATCC for STR analysis.

ATCC, a nonprofit, claims that all cell lines are STR-validated on their website. In addition, ATCC touts a database that scientists can use to compare

Image: Staff training is of paramount importance. Train your staff yourself and if you are new to cell culture, make sure you find someone who has lots of experience or an online journal and learn from them. Image from Shutterstock Images.

their results against profiles of documented human cell lines.

Profiling has limitations, too. While these methods are useful in establishing identity, they do not assess cell purity, i.e., absence of interspecies cross contamination or contaminants, such as viruses and microbes, phenotype, morphology, or cell ploidy.

Mark Rothenberg, Ph.D., manager of scientific training and education at Corning, warns that a strong mycoplasma testing program should be in place. “Mycoplasma can stay viable six to eight days in a drop of liquid in a hood and can easily contaminate the whole facility,” he explains. Additionally, although it runs counter to protocols established in most labs, he says that you should consider not using antibiotics in your media, unless establishing primary cultures. “Antibiotics can hide the presence of bacteria and increase the risk of contaminating other cultures.” He strongly recommends a reference article written by Corning about how to manage contamination.[3]

Curbing contamination— Using technology and common sense

No matter the sophistication of the space or the technique, good old common sense can go a long way. Brian Langenderfer, a senior sales representative, has worked with DAI Scientific for 22 years. He says one of the biggest mistakes he sees is the setup of cell culture space in high traffic areas such as next to a doorway.

Natalie Swartz is a lab designer with SmithGroupJJR in Detroit who works with universities and scientists to design spaces that match their needs: “We try to design for flexibility; this is the biggest innovation that we see on our end.” Flexibility means benches on wheels with adjustable heights. Ergonomics are built into these modular components so scientists can stand or sit depending on the task.

When possible, she suggests that researchers focus on a “triangle design,” meaning that the biosafety cabinet, refrigerator, and incubator are installed strategically and in close proximity, while taking certain precautions. For example, “Flow hoods should not be set up across from each other because the airflow could contaminate your samples,” she says. “Similarly, you want equipment three or four feet from biosafety cabinet so you can pull out your samples safely.”

Rothenberg adds that “incubators should be placed in a location with minimal potential for vibration from heavy equipment and elevators.”

All of the experts mentioned that when setting up your cell culture space you should consider what supplies you will use while at the biosafety cabinet.

You should be able to reach most of these items without leaving your seat. The less you disturb the air around your cells the better.

According to Swartz, most labs were designed in the 1970s and then remodeled in the early 2000s. Typically, older labs have equipment spread out with the refrigerator, incubator, and hood in different rooms. But all that transport is not good and provides myriad opportunities for compromising a sterile space.

If you are one of the many scientists working with limited resources in an older space, there are plenty of steps you can take to design a successful cell culture space.

Swartz advises that you consider three main aspects when setting up a working space: organization, consolidation, and the above-mentioned triangle configuration. "First, organize the space. Try to consolidate all the things you are going to use by task. You can create task zones where all of the materials you need are in one place. Use wheels to move things to the biosafety cabinet," she explains. Also, whenever possible you should follow the NIH guidelines.[4]

Rothenberg echoes Swartz and explains that you can work within the confines of the facility. Some things can't be avoided. For example, if there are windows, make sure they are sealed.

Innovation is only as good as the people who use it

Some cell culture mishaps can also be prevented with the proper equipment. Langenderfer believes that technology with certain features can prevent a lot of headaches if it is used properly. Consider the case of the super pure deionized water; just because it is super clean doesn't mean it should be used for every task. "For years, labs have been using deionized water in incubators, which is not recommended, because the water will pull the ions from the metal and over time create rust pitting inside," he cautions.

"On the hood [side of things], if lab personnel use the UV light to substitute for good aseptic technique then we, as [sales] reps, cannot control this. However, there are features like a UV timer, and one-piece stainless steel interior that will help with making the cleaning process faster and easier," says Langenderfer.

He continues, "Some incubators do not have good controllers, hence may not set off an alarm if a lab tech leaves a door open or forgets to change the water in the humidity pan. Most mishaps that occur in a lab are related to training of the lab techs by the researcher with regards to cell culture process in general. We do all the free in-service training on all our equipment. We also cover proper use and setting of all the controllers. In most cases, yes, the equipment is great if the lab personnel use and maintain the equipment properly."

Newer equipment takes into consideration the packed and strenuous day of scientists. Features include alarms, adjustable heights and wheels for chairs, hoods, and benches, as well as improved antimicrobial surfaces. And while an entire article could be written on it, both Swartz and Langenderfer stressed the importance of utilizing energy-efficient devices whenever possible. If part of your grant is earmarked for operational costs, this is definitely something you'll want to consider. That old incubator or hood you inherited for free might not be worth it in the long run. And do your legwork. "Don't just buy the same old incubator your advisor had," says Ligon.

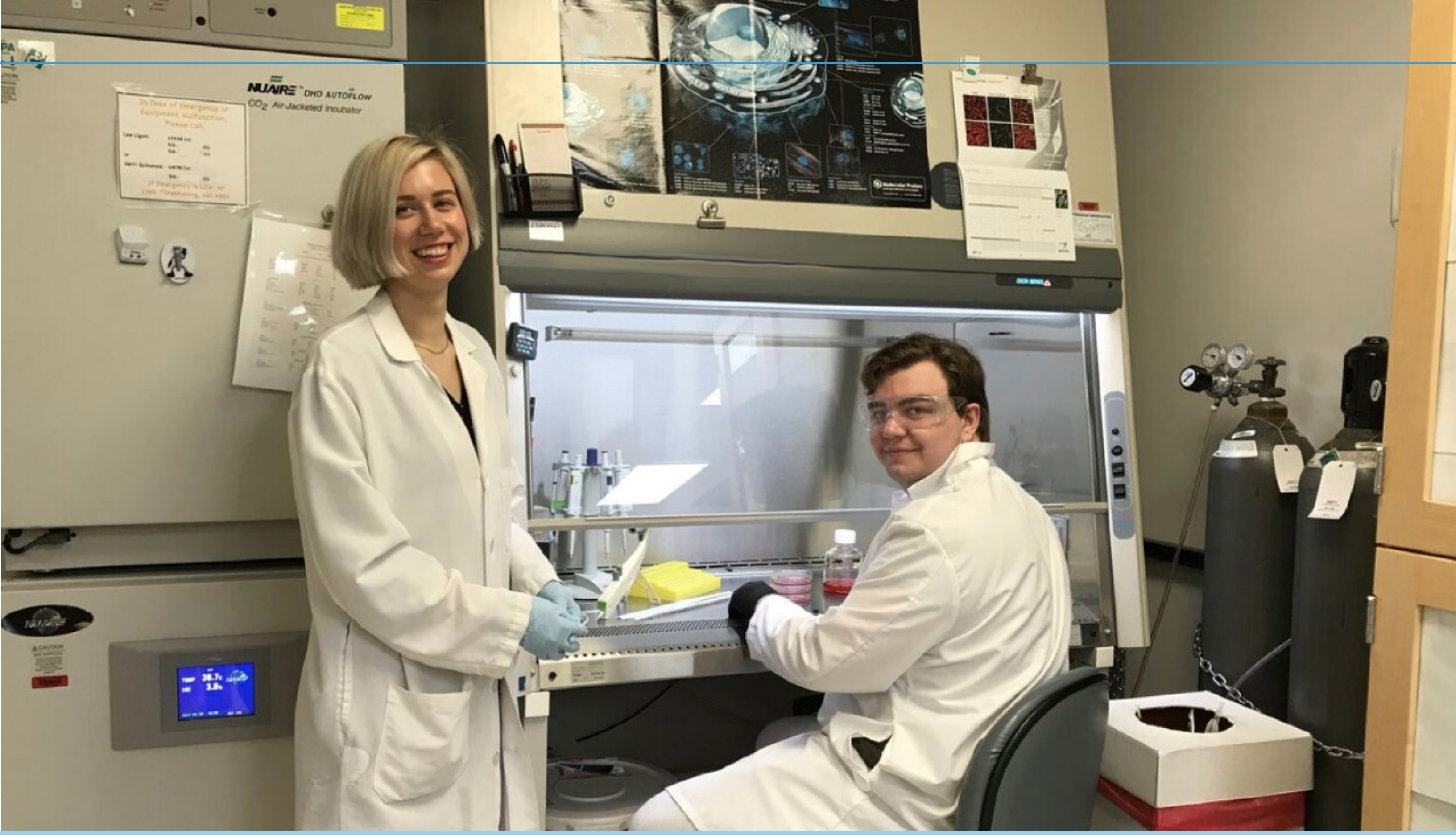


Image: Members of Lee Ligon's lab

Swartz warns that one fume hood consumes as much energy as 3.5 households per day, which is a massive amount. Whenever possible, choose a variable air hood over a constant volume hood. Also, "Lower the sash as much as possible," she advises. "If you do use a lower sash or a low flow velocity hood you can save up to 40% of your operating budget."

Langenderfer offers some parting advice: "When setting up a cell culture lab or any research lab don't just purchase the major equipment from a catalog; contact an equipment expert. In the end this will save you time and precious research dollars, as well as get you the exact equipment to match your research application."

References

1. Geraghty, RJ, et al., "Guidelines for the use of cell lines in biomedical research," British Journal of Cancer, 111(6), 1021–1046, 2014.

2. Freedman, LP, et al., "Reproducibility: changing the policies and culture of cell line authentication," Nature Methods, 12(6):493–497, 2015.

3. Ryan, J, Understanding and Managing Cell Culture Contamination, Technical Bulletin, Corning Life Sciences.

4. NIH Design Policy and Guidelines, Office of Research Facilities.

About the Author

Lauren Tanabe has a Ph.D. in pharmacology and molecular signaling from Columbia University. She completed her postdoctoral work at the University of Michigan as a Dystonia Medical Research Foundation Fellow and at Wayne State University as an American Cancer Society Fellow.

Providing a Stable Home for Precious Cellular Samples

Some obvious, and some not-quite-so-obvious, decision points for a new CO_2 incubator.

Josh P. Roberts

The CO_2 incubator, along with the laminar flow tissue-culture hood (Class II Biosafety Cabinet), is a mainstay of any cell-culture laboratory—so much so that it's generally part of the package supplied to incoming investigators at the University of North Carolina's Lineberger Comprehensive Cancer Center.

Because there are so many things to consider when deciding which incubator might be right for your lab—from size, cost, and its ability to prevent and deal with contamination to the user interface and to how temperature, humidity and gases are regulated—other important considerations may be overlooked initially. Here we examine some obvious, and some not-quite-so-obvious, decision points for a new CO_2 incubator.

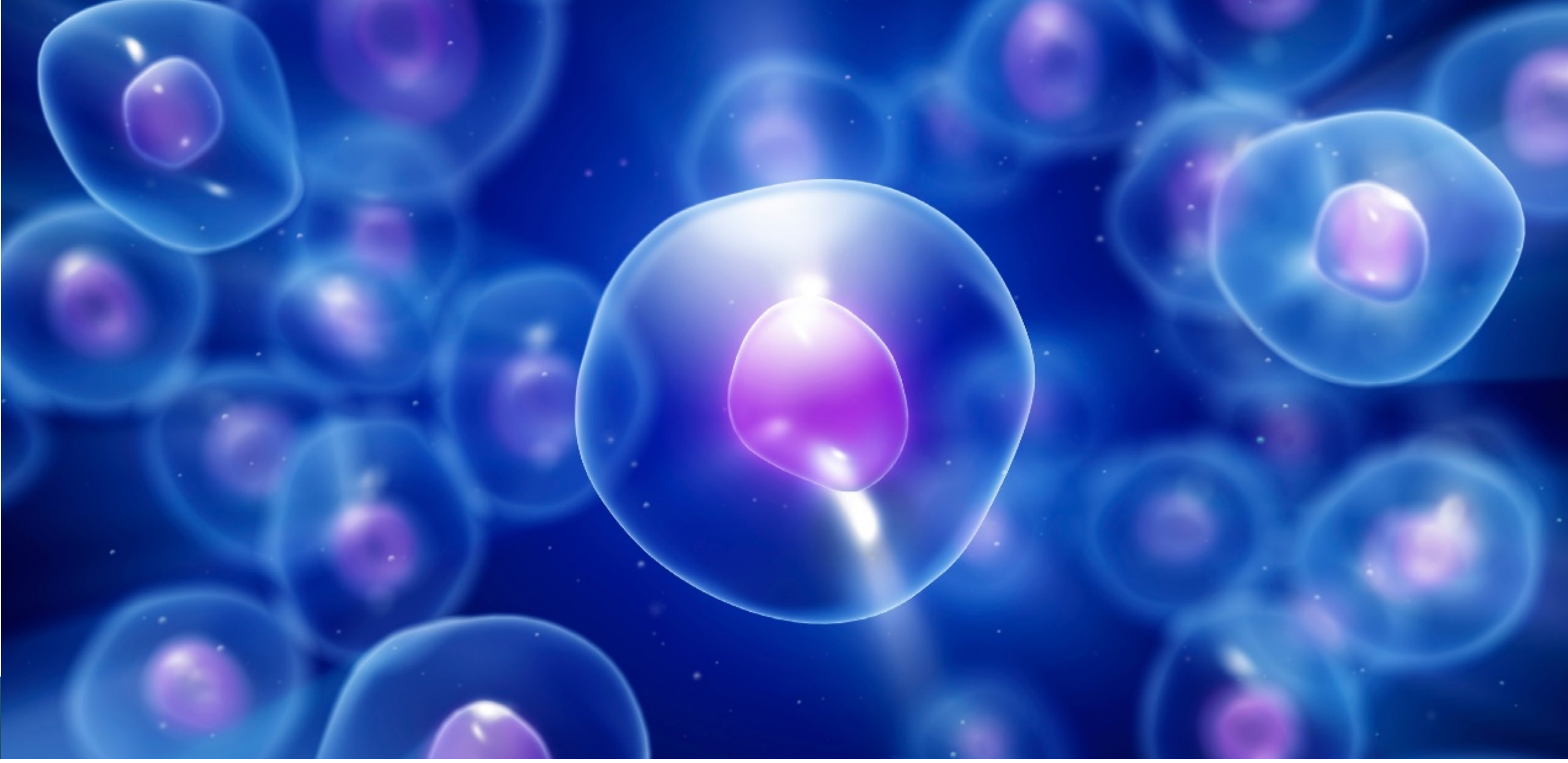
Size matters

Defining a "standard-size" CO_2 incubator can be a challenging task. That being said, a typical CO_2 incubator is in the roughly five- to seven-cubic foot, or 140- to 200-liter, range, allowing it to be placed on a bench or on the floor.

"Generally, all the incubators available today will be separate but stackable—most people will get a stack of two," says Steve Oglesbee, longtime director of the Lineberger tissue-culture facility.

It's good to know ahead of time where the incubator will be placed so that it can be ordered with the doors opening in the correct direction, he notes. "It depends on where the air is coming from, because you don't want room heating or air-conditioning air to be blowing into a chamber when you open it up—so right or left hinging can make a big difference for blocking that." Although doors may be reversible, it may require a service call to do so.

Castors or roller platforms can typically be ordered for direct heatt, floor-mounted models. Not only does this make relocating incubators easier, "it's really great, because it allows you to get to the back of the instrument much more quickly," says David Killilea, staff, scientist at the Children's Hospital Oakland Research Institute. Killilea created and manages an academic core facility.



Keep it simple, keep it clean

With temperature, CO_2, and humidity well controlled in the modern incubator, perhaps the most pressing general concern is the prevention and elimination of contamination: bacterial or fungal growth within the incubator, cross-contamination from other cultures, or something introduced from outside.

Many incubators are designed with smooth, seamless interior surfaces to minimize growth and make the unit easy to clean.

Robert Hunter, program manager of the University of Washington's Transgenic Resources Program, whose core had experienced a couple of fungal outbreaks, had chosen copper interior in place of other costly add-ons. But Killilea didn't like the "ugly green/brown patina" that forms when pure copper oxidizes, nor the dust that eventually comes off, so he opted for a stainless-steel alloy that "had enough copper to be antimicrobial."

Routine maintenance, like a weekly wipe-down, changing the water and water pan, and changing the HEPA filters (where applicable), can go a long way. Oglesbee cautions before you buy to make sure those filters are accessible and can be easily changed by lab personnel.

And when contamination does occur—there's an adage that "it's not if, but when"—vendors have a variety of ways of dealing with it. Most common in dry-jacketed incubators are either wet or dry heat cycles; these are typically overnight, but some are faster. In the past, some incubators required preparations such as removing sensors that could not tolerate the heat. Be sure to find out what the procedure is for the instrument you're looking to purchase. Other less common options, such as H_2O_2 or other chemical sterilization, may be available, as well.

Breathe deeply and keep it cool

With accumulating data supporting the idea that cells do better under more physiological hypoxic conditions—especially cells such as stem cells, 3D cultures, and primary cells that have not been adapted to culture—many researchers are looking

Image: Deciding which incubator might be right for your lab involves more than just considering size and cost. Image from Nuaire.

Image: CO_2 incubators are designed to keep precious cultures safe and happy. Image from Nuaire.

for incubators that can reduce oxygen content. This is most commonly achieved by allowing nitrogen gas to offset the oxygen, and it requires an oxygen sensor as well as nitrogen regulation.

If a researcher will be putting equipment—a shaker or a microscope, perhaps—into an incubator, they'll likely need power and perhaps other cables that go to the exterior. Oglesbee advises to make sure there are ports designed for the purpose and to plan placement of the incubator accordingly. If that equipment generates enough heat—especially if the room itself is very warm—a unit with refrigeration capabilities may be necessary.

CO_2 incubators are designed to keep precious cell cultures safe and happy. To keep the users happy, a host of bells and whistles—from automated decontamination to password protection, data logging, and onboard help screens—can be had, for a price.

About the Author

Josh P. Roberts has been a full-time biomedical science writer for more than a decade. Josh has an M.A. in the history and philosophy of science, and he also went through the Ph.D. program in molecular, cellular, developmental biology, and genetics at the University of Minnesota, with dissertation research in ocular immunology.

Key Considerations: When Purchasing Your Biological Safety Cabinet

The purchase of a biological safety cabinet should be made with much consideration. These cabinets serve as the Primary Engineering Control as the first line of defense in providing personnel, environmental and/or product protection against biohazards and potentially harmful agents in a range of laboratory, research, clinical and industrial settings.

To ensure that your laboratory is functioning properly at a high safety level, providing a high-level biological safety cabinet that helps facilitate an optimum working environment -- requires doing some investigation. A clear understanding of the important role these cabinets play in research and clinical environments will help ensure your laboratory is prepared to make sound, factbased decisions regarding the biological safety cabinets that will best meet your current and anticipated needs.

What is the value of a biological safety cabinet?

So why a biological safety cabinet? And why is it required to be knowledgeable about the cabinet before making a decision on what type of cabinet to purchase? Laboratory safety or the need to protect personnel and the environment from exposure to biohazards has never been more pressing. In our increasingly globalized world, a range of factors has increased the potential risks that biohazards pose. Today's antibiotic-resistant bacteria like Methicillin-resistant Staphylococcus aureus (MRSA) as well as rapidly mutating viruses, such as Ebola or HN51, pose an increasing risk to laboratory personnel safety. Meanwhile, increased international trade also means considerably more transportation of biohazards to testing labs and research centers with a greater chance of a pathogen being improperly handled and people being exposed.

Recently, the risk of laboratory exposure made headlines with two incidents at Centers for Disease Control and Prevention (CDC) laboratories. The CDC announced improper handling of anthrax and avian flu at its laboratories. The agency has since released a full report on the incidents and announced new actions and procedures that have been implemented to reduce the possibility of future problems. However, the incidents provide an urgent call-to-action to ensure that laboratories, and other environments in which biological materials are handled, have performed a relevant risk assessment, procure proper state-ofthe- art engineering controls, and increase vigilance to mitigate contamination exposure that would potentially put personnel, the environment and others at risk.

The laboratories safety starts with risk assessment and followed closely with engineering controls, the primary being the biological safety cabinet, plays a key role in ensuring that infectious "microorganisms" and potentially harmful particulates and/or aerosols can be handled safety.

Specifically, biological safety cabinets commonly use High Efficiency Particulate Air (HEPA) filters for biohazards in their exhaust and/or supply systems to provide safe, particle-free air. It is these cabinets that provide a safe, secure way of handling materials until they can be used properly or disposed of according to industry guidelines.

Determining your specific needs

Biological safety cabinets are used in a wide range of laboratory environments for life science, clinical and industrial applications. The type of environment -- and the specific applications that will be performed -- are key considerations in dictating which type and classification of cabinet will best meet the needs of workers, while providing optimum protection.

The first step is preform a detailed risk assessment with a Certified Biosafety Safety Professional (CBSP) or Industrial Hygienist who has knowledge of the risk levels associated with specific biological materials and chemicals that may be used in a laboratory setting. This will help to determine the type of materials used in the cabinet as well as the potential risks. The risk assessment should focus on three critical areas:

- Personnel protection from harmful biological agents inside the cabinet.
- Product protection to avoid cross contamination of the work, experiment or process being performed.
- Environmental protection from contaminants that are used within the cabinet.

Each of these areas contain specific risks, underscoring the importance of giving each full consideration when developing the risk assessment. Critical to a successful risk assessment is making sure the input you receive is comprehensive from your Certified Biosafety Safety Professional (CBSP) or Industrial Hygienist.

Class considerations for biological safety dabinets

After determining your specific risk, the next step is to assess how those risks will be fully met by the proper class and type of Biological Safety Cabinet to be purchased. There are different Classes of biological safety cabinets based on the level of protection they are required to provide. In addition, within those classes are various Types designed to address specific needs. The National Sanitation Foundation (NSF) has established performance standards that cabinets must meet to be Classified and listed as a specific Type of cabinet.. The standard NSF/ANSI 49 for Biosafety Cabinetry is reviewed every five years and it's recommended to certify your cabinet on an annual (according to NSF/ANSI 49) to biannual basis (according to standard USP <797> for Compounding Pharmacy Products). In addition to on-site staff, it is required to solicit input from a qualified biosafety officer as well as Environmental Health and Safe-

LARGE CAPACITY. SMALL FOOTPRINT.

NuWind centrifuges by NuAire.

nuaire.com/nuwind

ty (EHS) professional. It is smart as well to seek out product performance information from technically competent manufacturing representatives to assist with cabinet selection.

Below is a high-level overview of Biological Safety Cabinet classifications.

• Class I – Offers personnel and environmental protection only. Personnel protection occurs by constant movement of air into the cabinet and away from the user. Meanwhile, the environment is protected by filtering air before it is exhausted. A Class 1 cabinet does not protect the product from contamination. As such, a Class 1 cabinet is suitable for work involving low to moderate risk agents where there is a need for containment, but not product protection. Learn more how Class I Biosafety Cabinets work.

• Class II – A Class II Biosafety Cabinet must meet established safety requirements for protection of product, personnel and the environment as defined by NSF/ANSI, EN12469 or another internationally recognized organization. A Class 2 cabinet provides personnel, product, and environmental protection through HEPA filtration, laminar airflow throughout the work surface, and an air barrier at the front of the cabinet by use of a vacuum. Within the Class II classification, sub-categories have been established to define specific Types of Class II Cabinets, in terms of design, performance and installation attributes in which varying degrees of air recirculation or exhaust airflow is required. Use of materials that generate gases or vapors require an exhaust connection to a facility exhaust system. Learn more how Class II Biosafety Cabinets work.

• Class III - The Class 3 cabinet was designed to work and handle highly infectious microbiological agents, unknown agents, and/or to conduct hazardous operations providing maximum protection for personnel and the environment. The Class 3 cabinet is completely gas tight providing access to the work zone only through an isolation area that can be routinely decontaminated between uses. Personnel access the work zone to manipulate agents through heavy duty rubber gloves. Exhausted HEPA filtered air must pass through two additional HEPA filtered or a HEPA filter and air incinerator before being discharged back into the outdoor environment. Learn More how Class III Biosafety Cabinets work.

Shop NuAire Biological Safety Cabinets

Design and construction considerations

Once the specific Class and Type of Biological Safety Cabinet is determined, the next key consideration is whether the cabinet might be the proper fit for the laboratory environment and also if the cabinet configuration will have the flexibility required to meet present and future challenges within a specific laboratory. Among the questions to consider:

- Is the cabinet ergonomically designed in a way that allows for optimal comfort for those working?
- Can the cabinet be configured to improve process, productivity and safety?
- Does it have state-of-the-art safety features (i.e. audible and visual airflow alarms) and accessories to ensure the safest environment for lab personnel?

- What are the design specifications and materials and how do they compare with other products on the market? Aligned with those questions, some specific considerations include:
- Ergonomics – Is the cabinet designed to meet the ergonomic needs of the intended users?
- Width of cabinet – Is the width appropriate for the intended application and will it fit in the available space?
- Base stand options – A range of options exist including fixed (sitting or standing height), telescoping, adjustable, etc.
- User friendly – Is the cabinet easy to access, and help facilitate work?
- Service/maintenance friendly – Is the cabinet easy for an accredited Certifier to maintain and certify? Does the manufacturer provide any service assistance? At what level? Is the manufacturer easy to contact?
- Energy efficiency – What are potential costs of operating the cabinet from an energy consumption perspective?
- Filter life – How long will filters last in comparison to other brands?
- Noise levels – Is the noise level distracting?
- Lighting – Is the lighting adequate for the most efficient handling of materials?
- Total cost of ownership – What are the estimated costs over the lifetime of the cabinet's operation, as opposed to only considering upfront costs?

Training

The best biological safety cabinet in the world is only as good as those who are using it. That means proper education and training are essential to ensure the cabinet operates to its full potential. The laboratory director and qualified biosafety professionals should ensure the proper training of personnel. They should also establish and continually update policies, procedures and Standard Operating Procedures (SOP) to ensure that only those with proper training and clearance are permitted to enter the lab and work in Biological Safety Cabinets.

Typically, a reliable manufacturer will provide appropriate upfront training and education during the purchasing, installation and operation process. Watch NuAire's Working Safely Series. Check out their track record of ensuring personnel are aware of the necessary training.

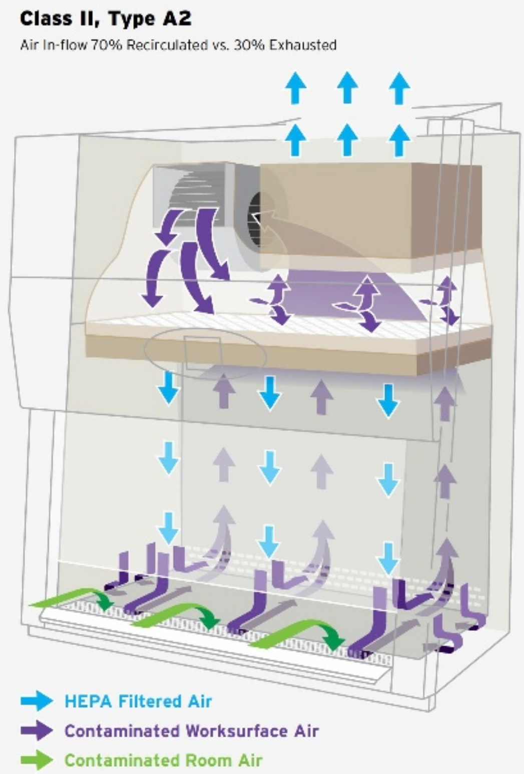
In addition, the process doesn't end once a biological safety cabinet is purchased, installed and operational. Closely review what the manufacturer offers in terms of ongoing support. What are the specifics of the warranty? What is included (parts, labor)? For how long? Etc.

Further, consider how long the company has been in business and its reputation for building and maintaining quality products and service.

Conclusion

Ultimately, the effective purchase of the proper biological safety cabinet is a team effort that involves capturing input from a range of individuals and professionals who can offer insights and expertise that will help guide the purchase decision.

The Class II, Type A2 Biological Safety Cabinet use HEPA filters in both the supply and exhaust system to produce and maintain product, personnel, and environmental protection.



Much like the procedures and experiments being performed in the laboratory itself, a systematic approach is best. Develop a strong working knowledge of biological safety cabinets as the primary engineering control in the laboratory, perform a thorough risk assessment, determine the Class and Type of cabinet required and assess the critical needs of the users. Also make certain that adequate and ongoing training will be provided and have a clear understanding of the support that is offered after sale and installation of the cabinet.

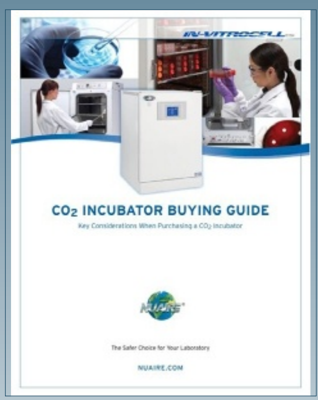
By taking these steps, you will not only be in the position to make a wise and informed purchase, but also ensure the safety of your personnel and working environment.

Have questions? Want to Learn More? Contact us online or by phone 763-553-1270.

References

1. Chosewood, L. Casey, MD, and Deborah E. Wilson, DrPH, CBSP, eds. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. N.p.: U.S. Department of Health and Human Services, 2009. Print.
2. NSF International Standard/American National Standard for Biosafety Cabinetry: Biosafety Cabinetry: Design, Construction, Performance, and Field Certification. Ann Arbor, MI: NSF International, 2012. Print.
3. <797> Pharmaceutical Compounding—Sterile Preparations. N.p.: United States Pharmacopeial Convention, 2008. Print.
4. Chosewood, L. Casey, MD, and Deborah E. Wilson, DrPH, CBSP, eds. Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets. 3rd ed. N.p.: Centers for Disease Control and Prevention & National Institutes of Health, 2007. Print.

Resources



[ebook] CO_2 Incubator Buying Guide

[ebook] Laboratory Centrifuge Buying Guide

[White Paper] Ultralow Freezer Buying Guide

[White Paper] Purchasing a Biosafety Cabinet, Who to Involve

Biocompare

Biocompare
395 Oyster Point Blvd., Suite 300
South San Francisco, CA 94080

Tel: 800-637-1277
info@biocompare.com
www.biocompare.com