

# LAB

R E P O R T E R

Innovative Products and Science News  
NO. 1, 2019

# Sustainability

## The Science Protecting Humanity

### Also in This Issue:

Nature-Inspired Carbon Capture  
Gated Membranes Improve Water Filtration  
Biosensors Are Redefining Rapid Diagnosis  
Mycobacteria: Exploring the Life in Your Showerhead

This issue of  
*Lab Reporter*  
is sponsored by

**Honeywell**

 **fisher scientific**  
part of Thermo Fisher Scientific

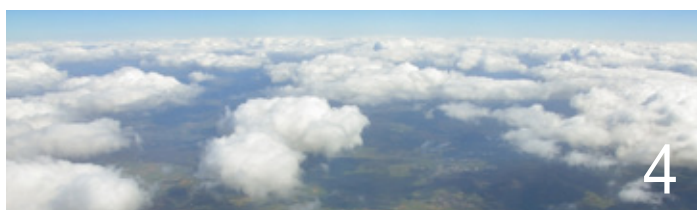


# CONTENTS



14

**14** **FEATURED ARTICLE**  
Sustainability: The Science  
Protecting Humanity



4

**4** **CHEMICALS**  
Greenhouse Gas Recycles  
as It Cleans Atmosphere



10



24

**10** **CONSUMABLES**  
Gated Membranes Improve  
Water Filtration



39

**24** **LAB EQUIPMENT**  
Biosensors Are Redefining  
Rapid Diagnosis



42

**39** **LIFE SCIENCES**  
Mycobacteria: Exploring the  
Life in Your Showerhead

**42** **SAFETY**  
Nature-Inspired  
Carbon Capture

## CONTACT US

U.S.: 1-800-766-7000 [fishersci.com](http://fishersci.com)  
Canada: 1-800-234-7437 [fishersci.ca](http://fishersci.ca)

# Honeywell

Check out page 8 for more great content from  
the sponsor of this issue of *Lab Reporter*: **Honeywell**

Lab Reporter provides quick and easy access to today's cutting-edge products and trusted solutions for all of your scientific research and applications.

## Supplier/Product Guide

### CHEMICALS

Alfa Aesar Rare Earth Metals .....	6
Avantor Chemicals .....	9
Honeywell Returnable Chemical Containers.....	8

### CONSUMABLES

BrandTech accu-jet pro Pipet Controller .....	13
Cole-Parmer Masterflex Pumps .....	12
<i>fisherbrand</i>	
Fisherbrand Fridays .....	20
Fisherbrand Glassware .....	21
Fisherbrand Maxima Pumps .....	18
Fisherbrand Ultrasonic Cleaners .....	19

### LAB EQUIPMENT

AirClean Systems Enclosures .....	29
Heidolph HEI-TORQUE Stirrers .....	38
Kent Scientific Animal Surgical Equipment.....	35
KNF Neuberger LABoport Pumps.....	35
Labconco BSCs .....	37
Mettler Toledo Balances .....	30
MilliporeSigma Milli-Q Water Systems.....	31
Mystaire Hoods.....	34
Nor-Lake Scientific Cold Storage.....	36
OHAUS Pioneer Balances .....	37
Thermo Scientific Undercounter Refrigerators .....	26
VACUUBRAND Vario Vacuum Systems.....	38

### LIFE SCIENCES

Analytik Jena UVP ChemStudio Plus .....	41
Corning Axygen PCR Strip Tubes .....	40
Invitrogen Antibodies .....	41

### SAFETY

Decon CiDehol and Peroxigen.....	46
PURUS Biohybrid Mats .....	44

**Note:** To check pricing, please log in to your account.

#### Supplier and Other Trademarks:

accu-jet, ACT, Advantor, AirClean Systems, AirSafe, Analytik Jena, Axygen, Biohybrid, BRAND, BrandTech, Burdick & Jackson, ChemStudio, Chromasolv, CiDehol, Cole-Parmer, Corning, Decon, Duran, DWK, E-POD, ech2o, Endeavour, EverSafe, HEI-TORQUE, Heidolph, Honeywell, Isola, J.T.Baker, Kent Scientific, KNF Neuberger, L/S, Labconco, LABoport, Latitude, Macron Chemicals, Masterflex, Mettler Toledo, MilliporeSigma, Milli-Q, Mystaire, Ohaus, Peroxigen, Pioneer, Purifier, PURUS, Q-POD, Quanta, Rare Earth Salts, Safe-T-Zone, Tygon, UVtect, VACUUBRAND, VACUUM•SELECT, VARIO, VISCO JET, YOUTILITY

#### Trademarks of Thermo Fisher Scientific:

Alfa Aesar, Fisher Scientific, Fisherbrand, Invitrogen, Lab Reporter, Nalgene, NUNC, Thermo Scientific

For trademark ownership, see [fishersci.com/trademarks](http://fishersci.com/trademarks).



## Are You a Subscriber?

In every issue, you'll receive:

- Essential resources, current promotions, and special pricing from premium suppliers
- Interesting and relevant editorial content that explores the latest headlines and leading scientific research

Subscribe for free at [fishersci.com/labreporter](http://fishersci.com/labreporter)







# Greenhouse Gas Recycles as It Cleans Atmosphere

By Christina Phillis

As researchers continue to refine their climate change models to make more reliable predictions, a simple molecule may play a significant part. The hydroxyl (OH) radical, which is known to break down other greenhouse gases, has been found to maintain or “recycle” itself in the atmosphere, according to a study by NASA researchers. Its sources and ability to replenish itself are important to note when trying to predict future amounts of greenhouse gases in our atmosphere.

## Simple Yet Mighty

Researchers were primarily interested in studying hydroxyl because of its ability to change the lifetime of other gases, including methane, second only to carbon as a contributor to global warming. This simple molecule is just a combination of one hydrogen atom and one oxygen atom with a free electron.

Before examining the results of this study, scientists believed that hydroxyl would be removed from the atmosphere as it interacted with methane, especially with increasing methane emissions. But when surrounded by other gases, hydroxyl remained. “When OH reacts with methane it doesn’t necessarily go away in the presence of other gases, especially nitrogen oxides (NO and NO<sub>2</sub>),” said atmospheric chemist and lead author Julie Nicely, PhD. After it reacts with methane, the products react with the nitrogen oxides to again form OH.

Our ability to resolve hydroxyl won’t revolutionize climate models, but it’ll increase our confidence in them.

To better understand the various sources of OH, NASA researchers used a computer model of satellite observations to study various gases during the period from 1980 to 2015. A new potential source of OH stood out: the growing tropical regions of the Earth.

The tropics appear to be expanding because of the rising temperatures that affect air circulation patterns. The tropics are also prime spots for OH creation because of the abundance of water vapor and ultraviolet sunlight. When light enters the atmosphere and reacts with water vapor and the ozone, two OH molecules are formed. The increase in tropical climates due to global warming has the potential to increase the level of OH in the atmosphere.

Although these additional sources of OH are respectively small, study researchers say they have a big impact, replenishing the OH used when breaking down methane. Goddard Atmospheric Chemist Tom Hanisco said there’s no guarantee OH levels will continue to recycle in the same way as the atmosphere evolves with climate change. But Dr. Nicely believes these results will help us better refine and predict the interactions of these two gases in the atmosphere, a major deciding factor in future climate change.

## Drilling for Answers

Complementing the NASA study is a separate project staffed by Australian and U.S. researchers, who are venturing to Antarctica to gather historical data on concentrations of hydroxyl. To capture samples that represent what the atmosphere was like before global warming, the team will extract air bubbles from 230-meter deep ice cores. Because hydroxyl only lasts for a second before it reacts with other gases, they will use Carbon-14 in carbon monoxide as a proxy.

To date, scientists have used only atmospheric models for determining hydroxyl levels. According to these models, concentrations have remained stable over the past 120 years, and started to increase with warming trends in the 1970s. The Antarctic researchers believe their work will help confirm the trends predicted by the atmospheric models.

“Our ability to resolve hydroxyl won’t revolutionize climate models, but it’ll increase our confidence in them,” said Matt Woodhouse, a climate modeler at CSIRO.

Research projects like these confirm that even the smallest details can help in the fight against climate change. Our ability to understand the simple hydroxyl molecule can have a big impact on our understanding of global warming.

# Rare Earth Metals:

## Exploring More Sustainable Supply Chains

From consumer electronics to the next generation of clean energy solutions, rare earth metals are needed for a wide range of technologies and applications. Although they help fuel sustainable initiatives, sourcing these elements has had a significant environmental cost. As the demand continues to increase, many industries are looking for eco-friendly and socially-responsible ways to obtain them.

### The Growing Importance of Rare Earth Metals

Rare earth metals are a group of 17 chemically similar elements, including the 15 lanthanides (lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium), plus scandium and yttrium. They are highly prized for their unique optoelectronic, magnetic, chemical, and structural properties, and play an essential role in the technological transformation of many industries.

Take your smartphone, for example. The vivid red, green and blue colors on its display wouldn't exist without europium, terbium and yttrium. Its speakers and microphone likely contain small, yet powerful magnets made from neodymium, while its tiny camera lens may use lanthanum.

In addition to consumer electronics, rare earth metals, alloys and compounds are essential to technologies like MRI scanners, which use gadolinium to improve the visibility of images and neodymium and praseodymium in the machine's magnets.

Some rare earth metals are also valued for their catalytic applications. For example, cerium, lanthanum and yttrium can be found in your car's catalytic converter that regulates the vehicle's emissions. They're also used in petroleum refining, chemical synthesis, waste water treatment, and in other industrial processes.

The hybrid electric vehicle (HEV) industry relies heavily on these elements as well, using neodymium, terbium and dysprosium in highly-efficient electric motors, and lanthanum and cerium in nickel metal hydride batteries. Cerium serves a second purpose, helping to polish the materials found in windscreen glass and wing mirrors.

Aside from the above applications, rare earth metals are used to produce the lightweight materials found in fuel-efficient aircraft, the permanent magnets in wind turbine motors and the optoelectronics in energy-efficient lighting.

### Finding and Extracting Rare Earth Metals

Despite their name, rare earth metals aren't actually that uncommon. Cerium, for example, is the 25th most abundant of the 78 elements most commonly found in the Earth's crust. But because these metals have similar geochemical characteristics, they tend to form together in nature, making it a challenge to locate concentrations worth the cost of extraction.

Isolating rare earth metals from ores requires intensive extraction and purification processes. Though new, more

environmentally friendly methods are in development, the traditional method of extraction involves repeatedly dissolving the ores in acids, ultimately producing large quantities of hard-to-recycle chemical waste.

Now, a new acid digestion process is able to selectively leach rare earth metals from coal fly ash. The chemicals used in this process are almost entirely recycled, providing an eco-friendly solution that reduces costs, excludes key contaminants and produces high-quality metals and other co-products.

### An Environmentally Responsible Route

Thermo Fisher Scientific recently established a partnership with Rare Earth Salts (RES), a United States-based company. The patented RES technology allows for separation and purification of rare earth metals in an environmentally-friendly way, offering significant improvements over other extraction methods. It has been proven at a commercial scale and can be used with most rare earth concentrates.

This collaboration will help the Alfa Aesar brand obtain new best-in-class rare earth metal oxides produced using industry-leading methods for cleaner separation and purification. The oxides produced consistently meet or exceed desired specifications, setting the process apart from that of existing technologies.

"Increasingly, our customers are demanding high-performance yet socially-responsible rare earth metals," says James Lovgren, Director of Product Management at Thermo Fisher Scientific.



“The separation and purification methods used in the production of our new range are amongst the most environmentally benign routes to compounds of these vital elements.”

Initially, five new rare earth oxide products (lanthanum, neodymium, praseodymium, yttrium and europium) will be added to the existing Alfa Aesar portfolio and the product line will continue to expand to include more oxides through 2019.

## The Future of the Industry

As the importance of rare earth metals continues to increase, many companies recognize the need to acquire them in environmentally and socially responsible ways. The commercial partnership with Rare Earth Salts will be expanding the Alfa Aesar range with premium and environmentally sustainable rare earth metal oxides, offering laboratories a reliable source for these critical materials.

Visit [info.thermofisher.com/rare-earths](http://info.thermofisher.com/rare-earths) to learn more and be notified when the new Alfa Aesar Rare Earth Oxides are available.

Content provided by:

**Alfa Aesar**  
by Thermo Fisher Scientific



# Choose the Right Chemical Packaging

The struggle to find a balance between escalating financial pressures and improving laboratory efficiency and output is a real concern. Lab managers face a conflicting set of demands and pressures to meet the needs of the lab, all with limited funds.

Labor costs represent as much as 60% of analytical laboratory budgets in industrialized countries, making it important to work efficiently. Considering the high cost of labor, it's important for lab managers to help improve workforce productivity in a way that effectively addresses an ever-increasing workload.

## Advantages of Automation

Enhancing productivity can be aided by automation, helping to achieve greater efficiency, accuracy and standardization. Adding this component to an existing workflow can reduce human error by 50 percent and increase output by nearly 75 percent.

Though a logical option, laboratory automation isn't the only way to maximize productivity. Manufacturers of analytical chemicals can also play a role in helping labs optimize their performance. Today, labs are willing to invest in premium-grade chemicals to ensure accurate results from critical analytical procedures. Many manufacturers even offer multiple solvent grades and have tightly controlled and reliable processes to produce such high-quality products.

## High-Purity Honeywell Solvents

When purchasing your lab's chemicals, look to the Honeywell Burdick & Jackson and Chromasolv lines of solvents. They're available in a range of purities and grades

and have excellent lot-to-lot consistency.

Honeywell acknowledges the importance of accurate deliveries that meet the demands of busy labs, especially when efficiency is a top priority. That's what makes their returnable container program beneficial, ensuring chemicals are delivered properly, in the right quantities and at the right time.

This program can help you reach your goals by decreasing costs and increasing time savings, ultimately accelerating research workflows and overall productivity.

## Benefits of the Returnable Container Program

Purchasing solvents in larger volumes and containers can minimize storage costs and optimize lab storage spaces, taking up 50 percent less space than glass bottles.

The reusable container program enables easy and contamination-free dispensing, even directly to instruments. The use of a fully-sealed system not only decreases a researcher's exposure to the chemical, but it increases the shelf life by maintaining purity. With their stainless-steel design, these containers also help minimize the risk of fires.

## Returning Empty Containers

To simplify the process, return instructions are attached to the container. When it's empty, Honeywell will collect and clean it, eliminating the need to rinse and dispose of glass bottles. This is not only very convenient, but it helps reduce packaging and hazardous waste.

The costs for round-trip shipping are included on your invoice and containers

are tracked by serial number. This setup accelerates the return process to help you maintain an adequate chemical supply.

## Sustainable Options

You can increase your efficiency while enhancing confidence when you choose high-purity solvents in returnable containers from suppliers who fully understand your needs.

The Honeywell returnable container program not only eliminates packaging waste, but it decreases analysis and process contamination, increases instrument and production run times, and is environmentally sustainable.

Content provided by:

**Honeywell**







 **avantor**<sup>™</sup>

Setting science in  
motion to create  
a better world

From breakthrough discovery to agile delivery of innovative laboratory products and services, Avantor is your trusted partner, committed to providing exceptional convenience, collaboration and customization to enable your success.

Visit [fishersci.com/avantor](https://fishersci.com/avantor) or [fishersci.ca/avantor](https://fishersci.ca/avantor) to learn more.





CONSUMABLES





# Gated Membranes Improve Water Filtration

By Iva Fedorka

A recently published update on a biologically inspired filtration mechanism shows promise as a method to reduce membrane failure and increase throughput.

## What Is Membrane Filtration?

Membrane filtration is a commonly used method for removing particulates and other contaminants from liquids. Industries like water treatment, chemical and petrochemical industries, food and beverage processing, biopharma and bioprocessing, and textile/paper/pulp all depend on membrane filtration. Filtration helps manufacturers achieve the necessary levels of purity, selectivity and throughput.

However, filters can become “clogged” or fouled, and membranes can deteriorate to the point of ineffectiveness. Researchers have explored various modifications to address these concerns: surfactants, coatings, chemical grafting, polymer blends, and plasma treatments. The method known as liquid gated membranes (LGMs) seems to address some of the limitations of these alternatives.

## The Current Situation

The domestic boom in shale oil and natural gas wells has contributed to the stress placed on surface and ground water supplies, with large amounts of water (approximately  $6 \times 10^6$  gallons) needed per well. Thermal distillation, reverse osmosis membrane systems, chemical precipitation, electrocoagulation, and filtration are the current preferred methods to remove suspended solids and reuse fracking fluids.

In water treatment, deposits or the adhesion of colloids and organic/inorganic particles to membrane pores and surfaces is the greatest challenge associated with microfiltration (MF) and ultrafiltration (UF) processes. Over time, the fouling increases hydraulic resistance, reduces filtration flux and detrimentally affects efficiency and economics.

Filtration issues have a direct effect on energy consumption and carbon dioxide emissions:

- Municipal wastewater treatment is responsible for 18 percent of total water-related carbon emissions
- Electricity demand for wastewater treatment is projected to increase more than 20 percent (to  $90 \times 10^6$  kWh/yr. or 0.3 Quads)

by 2050

## LGM Theory

LGM filters trap an immiscible liquid in the pores of the membrane to provide a smooth lining to the pore surfaces. The tension between the solution and the membrane surface is minimized, along with the amount of pressure required for active filtration. LGM parameters can be varied for filtering complex mixtures and for different filter media.

The presence of the gating also creates a barrier against the materials being absorbed into the membrane material. When liquid is trapped inside porous membranes, it acts like a control or gate that can adjust the transmembrane pressure (TMP), permit phase separation, and reduce build-up from particle filtration (PF), MF, and UF processes.

## New Possibilities

As published in *APL Materials*, researchers at the Harvard University Wyss Institute for Biologically Inspired Engineering, along with collaborators at Northeastern University and the University of Waterloo have developed a new version of an LGM.

## Next Steps

This study focused on the filtration performance of LGM technology for separating inorganic microparticles from an aqueous feed. (Hydrophilic bentonite suspension was tested to mimic the wastewater produced by oil and gas drilling operations.)

Although LGMs and more conventional filters were all eventually fouled by the suspension, the positive performance of the LGMs partially validates the technology and offers the possibility of reduced costs and electricity consumption related to filtration.

Additional research is needed to further test the LGM mechanism, and to demonstrate its feasibility for water treatment, bioprocessing and other industrial and high-impact processes.

This study was funded in part by the Advanced Research Projects Agency-Energy and the U.S. Department of Energy. The research was performed, in part, at the Center for Nanoscale Systems, part of Harvard University and a member of the National Nanotechnology Coordinated Infrastructure Network (supported by the National Science Foundation).

# Easy Setup and Operation

## Masterflex L/S Digital Dispensing Systems

Precision digital drive bundles offer a maintenance-free high-accuracy motor and a graphical interface for easy setup and operation.

- Available in an IP33 plastic enclosure or IP65 stainless-steel enclosure
- Anti-drip function ensures dispensing accuracy
- Open-head sensor



Maximum Speed	Maximum Flow Rate	Tubing Sizes	Mfr. No.	Cat. No.
600rpm	2300mL/min.	L/S 13, 14, 16, 17, 18, 25	77714-76	<b>11-747-340</b>
100rpm	380mL/min.	L/S 13, 14, 16, 17, 18, 25	77714-78	<b>11-747-342</b>
600rpm	2900mL/min.	L/S 15, 24, 35, 36	77714-77	<b>11-747-341</b>
100rpm	480mL/min.	L/S 15, 24, 35, 36	77714-79	<b>11-747-343</b>

All models include standard digital drive, Easy-Load II pump-head, open head sensor, and 6 ft. (1.8m) power cord. Use Masterflex L/S Precision Platinum-Cured Silicone (Tygon 3350) Tubing.



## Precise Meniscus Control

### BRANDTech accu-jet *pro* Pipet Controller

The BRAND accu-jet *pro* Pipet Controller offers precise, sensitive control, even with low-volume pipets. The insulated motor provides quiet, vibration-free pipetting. Multiple colors let you dedicate controllers for a specific laboratory or application.

- Contoured grip offers a comfortable fit for small or large hands
- Lightweight design prevents pipetting fatigue
- Control speed with pressure-sensitive buttons and motor-speed-limiter for small-volume pipets
- Up to eight hours of continuous pipetting per charge



Description	Mfr. No.	Cat. No.
Dark Blue	26330	03-840-310
Magenta	26331	03-840-311
Green	26332	03-840-312
Royal Blue	26333	03-840-313

## Touch the Future



### DWK Life Sciences Duran YOUTILITY Bottles

YOUTILITY Bottles have specially shaped gripping zones on both sides of the bottle for easier, safer handling.

- Graduated
- Made from Duran glass
- Ergonomic GL 45 bottles and caps
- Retrace code on bottles and closures



Description	Cat. No.	Cat. No.	Quantity
	<b>Amber Glass</b>	<b>Clear Glass</b>	
YOUTILITY Bottles, 125mL	02-900-100	09-841-065	4/Pack
YOUTILITY Bottles, 250mL	09-841-065	09-841-066	4/Pack
YOUTILITY Bottles, 500mL	02-900-102	09-841-067	4/Pack
YOUTILITY Bottles, 1000mL	02-900-103	09-841-068	4/Pack
<b>Accessories and Replacement Parts</b>			
YOUTILITY Screw Caps, GL 45, Polypropylene (PP), Cyan		09-841-069	10/Pack
YOUTILITY Pouring Ring, GL 45, Polypropylene (PP), Cyan		09-841-070	16/Pack
Bottle Tags, GL 45, Silicone, Two Each of Eight Colors		09-841-071	16/Pack
YOUTILITY 200 Self-Adhesive Label Sets, White Polyester Labels, Dispenser Box		09-841-072	1 x 200/Set





# Sustainability

## The Science Protecting Humanity

By Mike Howie



**In 1962, Rachel Carson** bypassed traditional scientific channels to deliver a message directly to the American people: unchecked pesticide use could kill you. Those chemicals, which at the time were indiscriminately dumped on public and private lands alike, didn't affect human health immediately. They weren't always the clear cause of an illness. But scientific studies showed that chemical pesticides inflicted far more damage on wildlife, nature and humans than was originally thought.

In some cases, the chemicals not only failed to control pests but actually allowed them to flourish in the absence of natural enemies — all while vast amounts of tax dollars were spent to spread poisons that collected in the tissues of animals, crops and people. When Carson presented these findings in her best-selling book *Silent Spring* that year, she gave the power of knowledge to the public, and many citizens became enraged with their government. Her reporting threatened the status quo of public officials and multimillion-dollar chemical companies, who sought to discredit her work and slander her name. And, most importantly, she began a dialogue that sparked the environmental movement and initiated a series of events that would produce the United States Environmental Protection Agency.

Nearly 60 years later, we continue to struggle with living sustainably and responsibly. The listless, grounded birds Carson wrote of have been replaced with dead whales whose stomachs are filled with discarded plastic. The dying elm trees of her day are the bleached coral reefs of our own. Even with the best intentions of reducing, reusing and recycling, we tax our planet in ways that could take hundreds of years to correct. Part of this stems from a natural urge to resist change, but it's also difficult to see the suffering forest through the seemingly verdant trees. The Earth is warming, but the weather isn't so different from last year. Pollution abounds, but we still feel healthy. As in Carson's time, the numbers and graphs that quantify our changing environment can be hard to decipher. It was her brilliant words that introduced many to the idea that we have to care for our environment in order to care for ourselves.

Carson's passion for our planet and its inhabitants continues to thrive at Chatham University, the alma mater she knew as the Pennsylvania School for Women. Nestled in the Shadyside neighborhood of Pittsburgh, Pennsylvania, Chatham's main campus features a 32-acre arboretum with 115 species of plants. Homes and buildings from the city's industrial days, including one formerly owned by businessman and banker Andrew Mellon, are now used as dorms, offices and classrooms. Following Carson's lead, the university cares for campus grounds without using chemical pesticides, and they've taken a number of steps to infuse every aspect of their operations with a sustainable mindset. No bottled water is sold on campus. Used cooking oil is sent to a

local biodiesel plant. Tax breaks are given to employees who bike to work. "I don't know any university that has [sustainability] in its DNA as much as Chatham does," said Peter Walker, PhD, dean of the university's Falk School of Sustainability and Environment.

"Ultimately, you care about the planet because you care about people"

The full extent of Chatham's sustainability expertise is found 20 miles north of the main campus in Richland Township, Pennsylvania — an aptly named area complete with rolling hills, lush woodlands and fall colors that rival the best New England has to offer. This is home to the university's Eden Hall campus and the Falk School, where students come to not only study sustainability but live it. The campus features over 400 large solar panels, a residence hall with the largest installation of radiant heating and cooling ceiling panels in the country, over 30,000 square feet of rain gardens, a variety of growing environments, on-site wastewater management and much more. Lessons in sustainability can be found in every aspect of the campus. But the school does not define itself with high-tech buildings, and it doesn't pursue sustainability for holier-than-thou credibility. Instead, the palpable goal is to solve real problems in real communities, to leave the Earth better than they found it and to set a lasting example for future generations. "We're not trying to be the techy leaders," Dr. Walker said, "we're much more on the people side."

Dr. Walker greets incoming sustainability students with two questions: "How many of you are angry about the way the world is, and how many of you think my generation screwed up your life?" Both are answered with a sea of raised hands. "I love that, it means they are passionate," he said. "What I say is I want you to keep that anger, I want you to keep that passion. What we're going to do is give you the smarts to be able to do something with it." Those smarts are imparted not just in the classroom, but also in the fields and forests of Eden Hall and communities in and around Pittsburgh.

*continued on page 17*







continued from page 15

# Sustainability The Science Protecting Humanity

Unlike other sciences, sustainability labs are not bound by geography or a single discipline. Sustainability scientists work to solve real-world problems, which have no real boundaries. Projects that start simply can quickly expand into other fields of study. A recirculating fish farm, for example, can become a project on the economics of growing fish food instead of purchasing it. A lab about green infrastructure can expand to include human motivation and communication if the crews tasked with installing it aren't properly trained. To see just how quickly these projects change course, Chatham students are given real-world problems to solve in the field.

“Don't seek perfection.  
Seek workable solutions.”

“People learn by doing things, primarily,” Dr. Walker said, “and they learn even better if they make mistakes and if they're having fun.” With that idea driving Chatham's pedagogy, the university partners with businesses and communities to make a difference in the lives of students and citizens alike. In Homewood, an economically challenged neighborhood of Pittsburgh, students are working on an ecovillage project that aims to revitalize the area without causing gentrification that could drive residents from their homes. In partnership with local farmers, they're developing a method for growing shiitake mushrooms using resources commonly found on Pennsylvania farms, which could add an additional \$5,000 to a farmer's annual income. Students even intern with local government offices to get a first-hand look at what it takes to drive sustainability efforts in a major city.

Chatham's educational aspirations don't end with students. The Eden Hall campus was purposely designed to blend in with the surrounding community and locals are invited to campus for a variety of events, including weddings, outdoor concerts, summer camps, and classes that include fermenting everything from wine to kimchi. By giving so many people a first-hand look at what it means to be sustainable, Chatham exemplifies the idea that sustainability starts locally. And by letting their pupils learn from failure, they teach that it's more important to try than it is to be perfect.

“One of the things that I've learned in my life is that perfection is the death knell of progress,” Dr. Walker said. “Don't seek perfection. Seek workable solutions.” In other words, it's possible that what we think is a sustainable solution today may in fact prove to be unsustainable in the future; what we really need are models that are good enough and can be applied now. As our knowledge of sustainability grows, those models will evolve and lead us to a sustainable future, one step at a time.

“Ultimately, you care about the planet because you care about people,” Dr. Walker said. That same moral imperative inspired Carson to write *Silent Spring*. When she published her book, she did so as an outsider with no PhD or academic affiliation. Fully aware of the fierce criticism she would receive, she persisted in working to clearly present scientific evidence to a public that had a right to know. And she defended that work in front of her country even as cancer spread through her body. She did this not to earn a posthumous legacy, but to stand up for the continued prosperity of humanity as a whole, even though she would never experience the brighter future she helped create. “You've got a good soul, so you care about people and future generations, and people you can't see on the other side of the world,” Dr. Walker explained. “That's really sustainability. It's not complicated.”





## Protective Coating, Functional Accessories

### Fisherbrand Maxima Rotary Vane Vacuum Pumps

Fisherbrand Maxima Rotary Vane Vacuum Pumps are durable and have superior vapor handling capability. Use these pumps for vacuum furnace evacuation, rotary evaporation, vacuum sterilization, mass spectrometry, freeze drying, vacuum centrifugal applications, vacuum distillation, and other processes that require a reliable vacuum. An exhaust filter, funnel, and hose clamp are included. A U.S. 115V cord is provided with 115V models.

The need to service these pumps is reduced by:

- Enhanced, corrosion-resistant coatings to protect from aggressive chemicals
- A large oil reservoir that dilutes harsh chemicals
- A cooling system that helps the pump run 10°C cooler than standard rotary vane pumps, which reduces chemical activity and slows the rate of oil consumption



Model	Displacement (Flow Rate) at 60Hz	Ultimate Vacuum	Dimensions (L x W x H)	Shipping Weight	Cat. No.
M4C	2.7 CFM (78L/min.)			63 lb. (29kg)	<b>01-184-202</b>
M6C	4.2 CFM (118L/min.)	5 x 10 <sup>-4</sup> torr (4 x 10 <sup>-4</sup> mbar)	18.2 x 6.1 x 9.1 in. (46 x 16 x 23cm)	63 lb. (29kg)	<b>01-184-203</b>
M8C	5.6 CFM (158L/min.)			65 lb. (30kg)	<b>01-184-204</b>
M16C	12.8 CFM (363L/min.)			200 lb. (91kg)	<b>01-184-205</b>
M24C	18.3 CFM (519L/min.)	3 x 10 <sup>-4</sup> torr (2 x 10 <sup>-4</sup> mbar)	22.4 x 8.1 x 11.4 in. (57 x 21 x 29cm)	103 lb. (47kg)	<b>01-184-206</b>
M30C	22.1 CFM (627L/min.)			106 lb. (48kg)	<b>01-184-207</b>



# Avoid Harsh Chemicals and Reduce Waste

## Fisherbrand Ultrasonic Cleaners

Fisherbrand Ultrasonic Cleaners allow you to clean discarded parts and restore them to working condition without the use of harsh chemicals. With a mild solution, they can clean a variety of items, including:

- Plastic cell phone cases
- Glass flasks with residual polymer, cannabis residue, and other stubborn substances
- Tips for paint spray guns

Fisherbrand 112xx Series Advanced Ultrasonic Cleaners are more powerful than conventional cleaners. They feature a wide range of adjustable parameters for lab applications, including cleaning, mixing, and degassing.

- Maximum versatility: choose frequency, power level, time, temperature, and mode
- Modes: normal, pulse, sweep, and de-gas
- Six tank sizes: 0.7 to 7.4 gallons
- Compatible with multiple cleaning solutions
- Full line of accessories (sold separately)
- Products in stock and ready to ship



Model	Capacity	Cat. No.
FB-11201	2.75L (0.7 gal.)	<b>FB11201</b>
FB-11203	5.75L (1.5 gal.)	<b>FB11203</b>
FB-11205	6.9L (1.8 gal.)	<b>FB11205</b>
FB-11207	12.75L (3.3 gal.)	<b>FB11207</b>
FB-11209	18L (4.75 gal.)	<b>FB11209</b>
FB-11211	28L (7.3 gal.)	<b>FB11211</b>



# *fisher*brand FRIDAYS

## Exciting Deals Every Week

Get exclusive offers on glassware, personal protective equipment, and more in your inbox each week with Fisherbrand Fridays.

The promotions are valid for just one day, so don't miss out on great savings every Friday.

Visit [fishersci.com/fisherbrandfriday](https://fishersci.com/fisherbrandfriday) to learn more.



# 25% Off Glassware

## Fisherbrand Pipets, Tubes, and Vials

### 25% Off Fisherbrand Disposable Borosilicate Glass Serological Pipets

Enter promo code **SEROPIP25** at checkout to save.

### 25% Off Fisherbrand Disposable Borosilicate Glass Tubes with Plain Ends

Enter promo code **DCT25** at checkout to save.

### 25% Off Select Fisherbrand Vials

Enter promo code **VIALS25** at checkout to save.

Valid through June 30, 2019. Discounts taken off list price. Restrictions apply.



Visit [fishersci.com/fisherbrandglassoffers](https://fishersci.com/fisherbrandglassoffers) to learn more.



# Everything You Need to Furnish Your Lab

Choose new Fisherbrand furniture solutions that maximize your budget and ship within 10 days of ordering.

## Our comprehensive line of lab furniture includes:

- Wall and tall casework
- Shelving systems
- Lab workstations
- And much more



Visit [fishersci.com/fisherbrandfurniture](https://fishersci.com/fisherbrandfurniture) or [fishersci.ca/fisherbrandfurniture](https://fishersci.ca/fisherbrandfurniture) to shop the collection.



# Bring Your Research Into Focus

## Fisherbrand Microscopes

Choose analog or digital compound, inverted, or stereo microscopes with a range of magnifications. Featuring improved optics, increased working distances, and larger bases that are more stable, redesigned Fisherbrand microscopes help make lab work easier.



Visit [fishersci.com/fisherbrandmicroscopes](https://fishersci.com/fisherbrandmicroscopes)  
or [fishersci.ca/fisherbrandmicroscopes](https://fishersci.ca/fisherbrandmicroscopes) to learn more.





# Biosensors Are Redefining Rapid Diagnosis

By Kevin Ritchart

Canadian researchers have built a diagnostic tool that gives healthcare practitioners a nearly instant diagnosis of bacterial infection. And it fits in the palm of your hand.

Scientists from the University of British Columbia-Okanagan (UBCO) and the University of Calgary teamed up to create a small, inexpensive biosensor that provides immediate, accurate results instead of the two to five days it takes to perform traditional testing. Their research was published in *Nature Scientific Reports*.

“Advances in lab-on-a-chip microfluidic technology are allowing us to build smaller and more intricate devices that can provide more information for healthcare practitioners while requiring less invasive sampling from patients,” said Mohammad Zarifi, an Assistant Professor in the School of Engineering’s Microelectronics and Advanced Sensors Laboratory at UBCO.

## The Challenges

According to 2017 statistics, the mortality rate from bacterial infections can increase by nearly 8 percent with each hour of delayed treatment, usually due to sepsis. There is a pressing need to find more rapid, cost-effective, and sensitive tests that can identify bacteria in the field or at the point-of-care, without multi-step purification or sample preparation.

The biosensor operates by sending a microwave signal through the sample.

Typically, patient specimens are tested using microscopy, bacterial culture, biochemical assays, immunological tests or genetic analysis.

- Microscopy uses bacterial staining to determine the shape and other characteristics; it takes little time but is non-specific.
- Bacterial cultures can take up to several days, and some bacteria cannot be grown in the laboratory.
- Biochemical assays detect bacteria-specific enzymes and include enzyme-linked immunosorbent assays (ELISAs) and agglutination methods.
- Genetic analysis and other molecular techniques offer more rapid bacterial identification using polymerase chain reaction (PCR), but these require preselected genetic probes to pair correctly with the bacteria’s DNA. This can produce false-positive results, and may not detect genetically mutated strains.

## How They Work

Zarifi and his team tested their biosensors using a variety of samples with bacteria levels that represented conditions routinely found in clinical microbiological laboratories.

The biosensor operates by sending a microwave signal through the sample, allowing it to perform a quick analysis and generate a profile of any bacteria present.

While speed and accuracy are the chief benefits of this technological breakthrough, the biosensors actually go a step further, according to Zarifi. They can help simplify the currently complex process of testing for antibiotic susceptibility, provide rapid detection of bacteria, and screen bacterial proliferation once antibiotics have been administered.

“The device is able to rapidly detect bacteria and in addition, it screens the interaction of that bacteria with antibiotics,” Zarifi said. “The combined results give healthcare practitioners more information than they currently have available, helping them move forward to determine accurate treatments.”

# Go Green with Thermo Scientific Products

Billions of pounds of plastic are discarded globally each year and laboratories are big contributors to this waste. Now research facilities have an opportunity to reduce their environmental impact through informed decisions and purchases, selecting greener options in the process.

My Green Lab, a non-profit organization, has piloted an environmental assessment label for laboratory products. The label assesses the accountability (A), consistency (C), and transparency (T) of manufacturing, energy and water use, as well as packaging and end-of-life disposal. The ACT system is intended to make choosing sustainable products easier.

## Benefits of ACT Labeling

With the ACT labeling system, laboratories have a way to make more informed purchasing decisions based on environmental sustainability. The label also provides a product “score” and offers helpful tips for disposal.

To qualify for the ACT label, products are assessed, scored and audited by an independent third-party company known as Sustainability Made Simple. The company considers Environmental Impact Factors (EIF) developed with input from scientists, sustainability directors, procurement specialists, and manufacturers to provide a comprehensive labeling program for life sciences products.

Scores are based on the recyclability of the product, its energy consumption and any sustainable manufacturing practices provided by the manufacturer. Data is verified and published by My Green Lab, reducing the chances for bias and increasing the ACT label credibility as a meaningful measure.

The scores are used to create an ACT label for each product, informing potential buyers about its environmental impact. In the spirit of sustainability, labels are published on [mygreenlab.org](http://mygreenlab.org) for

public access. Reading an ACT label is simple: most categories are rated from 1 to 10, with a lower score given to more environmentally-friendly products.

You can use these scores to compare the environmental impact of the categories most relevant to your lab. For more details on the product scoring process, visit the My Green Lab website.

## My Green Lab and Thermo Fisher Scientific

Demonstrating a commitment to sustainability, Thermo Fisher Scientific is participating in the My Green Lab program, offering insights into improved manufacturing procedures. A selection of Nalgene and Matrix products are now ACT labeled and may help to make sustainable purchasing a reality.

Visit [mygreenlab.org](http://mygreenlab.org) to learn more about ACT labels and to start making more environmentally informed labware choices.



**The ACT Label:**  
a guide for  
making greener  
product choices



## Fact Sheet: Thermo Scientific TSX Series Undercounter Refrigerators

These high-performance undercounter refrigerators were developed with better energy efficiency than models that use a conventional refrigerator.

### Key Features

- A unique variable or “V-drive” with synchronized temperature management (STeM) adapts to the environment
- Cold-wall technology and forced-air cooling keep temperatures stable for your sensitive samples, even during frequent door opening
- Two solid-state thermoelectric heat pumps are synchronized to modulate activity based on customer usage and generate energy savings by powering the system only as needed
- Non-hydrofluorocarbon (HFC) coolants help reduce environmental impact and further increase cooling efficiency

The TSX series also offers 42% more storage capacity than the earlier models in a similarly sized footprint. Also, with their quiet operation (35 dB vs 60 dB), they're an easy addition to your lab space.

### Important Changes

HFC coolants have been identified as contributors to global warming by the U.S. Environmental Protection Agency and European Commission. As a result, Thermo Fisher Scientific is eliminating

the use of these coolants in freezers and refrigerators and replacing them with more environmentally friendly alternatives that also offer better cooling efficiency.

### Green Advantages

TSX series undercounter refrigerators require 37% less energy to operate than models with conventional refrigerant. The newer models could help save more than 600 kWh of energy over the course of a year. This represents 0.43 tons of CO<sub>2</sub> equivalents, which is comparable to the greenhouse gas emissions from driving 1,032 miles in an average passenger car.

TSX refrigerators also produce less heat, helping to lower heating, ventilation and air conditioning (HVAC) costs. For example, the TSX505SA model emits

206.2 BTU (British Thermal Units), while the older, yet comparable REL404A model emits 616 BTU.

This combination of features and energy-use reductions can help all of us help the planet. Thermo Fisher Scientific is committed to creating products with the environment in mind so we can enable our customers to make the world healthier, cleaner and safer.

Visit [fishersci.com/tsx](https://fishersci.com/tsx) to learn more about Thermo Scientific TSX Refrigerators and Freezers.

Content provided by:

**thermo**scientific



# The Ductless Laboratory:

## Maximizing Safety, Flexibility and Cost Savings

Chemical fume hoods are typically the primary source of ventilation in laboratory facilities, helping provide a safe work environment for staff who handle hazardous or noxious chemicals. When deciding between conventional ducted fume hoods or ductless filtering fume enclosures, consider the following information.

### What are some characteristics of ductless fume hoods?

- Ductless fume hoods are suited for moderate usage (three to four hours per day)
- They have chemical filters that capture or neutralize organics, amines, acids, sulfurous compounds, aldehydes, and other specific families of chemicals
- If you use a variety of chemical compounds, it's best to choose a mixed-bed filter
- The number of chemicals should be limited to ten or fewer
- Ductless hoods may also have High-Efficiency Particulate Air (HEPA) filters to help remove powders and particulates

### What are some characteristics of ducted hoods?

- Ducted hoods are useful for applications involving particularly high temperatures or for large quantities of lightweight or volatile organic compounds that may be poorly captured by filters
- Specialty hoods may be needed for applications with specific risks, like radioisotope and perchloric acid handling

### Is my application suitable for a ductless fume hood?

- ✓ Ten or fewer chemicals are used
- ✓ No excessive heating required
- ✓ Limited chemical volumes (<500mL)
- ✓ Appropriate chemical filters are available
- ✓ Chemical exposure times are moderate (3 to 4 hours per day)

### Budgetary Benefits of Going Ductless

A typical ductless fume hood can cost three or four times as much as a conventional hood, although the additional costs for modifying ductwork, mechanical systems, exhaust fans, roof elements, and other infrastructure may make the total expenses about the same. Adding ducted hoods to your existing ventilation system will also require an engineering evaluation. A new or larger system may need to be installed if your system cannot accommodate the additions.

The airflow required by ducted fume hoods can also add to overall heating, ventilation and air conditioning (HVAC) costs. In fact, for a standard six-foot hood, the overall operation can range from 4,600 to 9,300 USD per year depending on the local climate<sup>1</sup>.

With more than 750,000 fume hoods in use in the United States alone, the potential energy and cost savings is high. The annual operating costs total approximately 4.2 billion dollars, with a peak electrical demand of 5100 megawatts<sup>1</sup>. Ductless systems allow conditioned air to be recirculated back into the lab, quickly reducing energy

usage and lowering the cost of operation. Replacement filters for ductless hoods cost between 350 and 2,000 USD per year, another area for significant savings in comparison to standard hoods.

### Efficiency and Flexibility

Ductless fume hoods offer convenient installation, while conventional fume hoods may require a long lead time and coordination with building support staff due to mechanical and HVAC upgrades and modifications. Your new system must also be inspected and certified prior to use.

Ductless hoods arrive fully certified and ready to use. They can also be placed in any laboratory space regardless of HVAC considerations and without assistance from maintenance or engineering personnel. This added flexibility minimizes downtime and allows you to adapt quickly to new applications and requirements.

### Addressing Safety Concerns

Since ductless fume hoods route filtered air back into the lab, there may be questions about the risk of chemical contaminants being released into the space. Modern ductless fume hoods are equipped with sophisticated monitoring systems and are backed by a long safety track record. In contrast, solvent condensation in ductwork and the buildup of flammable dusts in conventional fume hoods can present a much greater risk, sparking fires and explosions.

Whether you are purchasing fume hoods, upgrading your existing laboratory equipment or planning new facilities, consider ventilation options that maximize flexibility cost effectiveness and ensure the safety of your laboratory personnel.

Content provided by:

**AirClean<sup>®</sup>Systems**  
THE FUME CONTROL EXPERTS<sup>™</sup>

<sup>1</sup>Mills, E. & Sartor, D. (2006) *Energy Use and Savings Potential for Laboratory Fume Hoods*. Lawrence Berkley National Laboratory Energy Analysis Department. Berkley, CA.



# Ductless Chemical Workstations Laminar Flow Workstations

**AirClean**® Systems

## Ductless Chemical and Laminar Flow Workstations

The AirClean Systems Combination PCR Workstation combines an ISO 5/Class 100 Clean Air Environment with UV light sterilization for optimal protection from sample contamination. A UVtect microprocessor constantly monitors workstation functions.

### Standard Features:

- Class 100 clean vertical laminar flow air
- Polycarbonate and polypropylene design to reflect UV energy
- Digital UV light timer: 0 to 59 minutes
- UV shelf with integrated pipette holder

PCR Workstation	Cat. No.
AC632LFUVC 32" PCR Workstation	36-101-8894
AC648LFUVC 48" PCR Workstation	36-101-8897



## Endeavour Ductless Fume Hood

The Endeavour Ductless Fume Hood is designed to provide superior operator protection from potential toxic fumes, vapors, and particulates. AirSafe NXT provides simple and effective user interaction with fume hood operational parameters.

### Standard Features:

- Microprocessor controller with audible and visible alarms for both airflow velocity and filter change
- Bonded carbon filters — no dust!
- Polypropylene construction — excellent chemical resistance

Endeavour Ductless Fume Hood	Cat. No.
ACPT4000 48" Ductless Fume Hood	36-100-0063
ACPT5000 60" Ductless Fume Hood	36-100-0067
ACPT6000 72" Ductless Fume Hood	36-100-0069

Filters sold separately; application worksheet required.

## AC600 Series Ductless Chemical Workstation

The AC600 Series Ductless Chemical Workstation is an economical solution for protection of the operator and environment from toxic vapors, gases, fumes, and particulates. Ships fully assembled and can be configured for a variety of common applications.

### Standard Features:

- Microprocessor controller has audible and visible alarms for both airflow velocity and filter change
- 360° visibility
- Ideal for low-volume chemical applications

Description	Cat. No.
AC632A 32" Workstation	36-100-4271
AC632TA 32" Workstation, Tall Version	36-100-4272
AC648A 48" Workstation	36-100-4274
AC648TA 48" Workstation, Tall Version	36-100-4275



Filters sold separately, application worksheet required.



## Earn Up to Four Times the Fisher Scientific Buck\$ On the New XPR and XSR Analytical Balances

METTLER TOLEDO's new XPR and XSR analytical balances deliver exceptional accuracy and precision, making them the only choice for weighing applications that require the highest sample care.

ATC (Active Temperature Control), user management controls, and StaticDefect make XPR and XSR analytical balances ideal for highly regulated industries. Plus, for a limited time, you can earn up to \$1,800 (\$2,400 CAD) in Fisher Scientific Buck\$!

Learn more and make an evolutionary leap in your analytical weighing today by visiting [fishersci.com/mettlertoledo](https://fishersci.com/mettlertoledo).

Excludes healthcare practitioners. See page 48 for full details.

**METTLER TOLEDO**



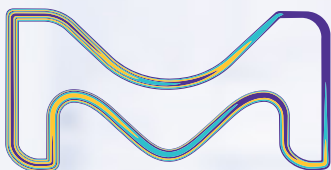
**Minimize complexity.  
Magnify your focus.**

## **Milli-Q® IQ 7003/7005**

**Integrated Ultrapure and Pure Water System**

- Simple and intuitive Q-POD® and E-POD® dispensers
- Touchscreen display for unparalleled ease of use
- Effortless data management and ensured traceability
- Compact and versatile to optimize lab space

Visit [fishersci.com/milli-q](https://fishersci.com/milli-q) to learn more.



MilliporeSigma, the vibrant M, Milli-Q, E-POD and Q-POD are trademarks of Merck KGaA, Darmstadt, Germany, or its affiliates. All other trademarks are the property of their respective owners. Detailed information on trademarks is available via publicly accessible resources.

© 2019 Merck KGaA, Darmstadt, Germany, and/or its affiliates. All Rights Reserved.

The life science business of Merck KGaA, Darmstadt, Germany, operates as MilliporeSigma in the U.S. and Canada.

**Milli-Q®**  
Lab Water Solutions

# Milli-Q IQ 7003/7005:

## Minimize Complexity, Magnify Your Focus

From improving productivity to reducing environmental impact, the new MilliporeSigma Milli-Q IQ 7003/7005 system offers a fully-integrated pure and ultrapure lab water solution designed to exceed the most demanding applications.

### Fewer Contaminants for Greater Confidence

The Milli-Q IQ 7003/7005 system is designed with purification media, hydraulics and enhanced software capabilities, delivering two types of purified water directly from the tap. The system gives you confidence in quality, helping to ensure you won't have to repeat experiments.

### Reduced Stagnation for Increased Protection

Using a redesigned and more advanced storage solution, the Milli-Q IQ 7003/7005 system protects your stored water, reducing stagnation and the risk of bacterial contamination.

### New key features include:

- Automatic recirculation of stored water within the purification loop
- A more seamlessly integrated vent filter that provides improved protection against airborne contaminants
- A built-in automatic sanitation module (ASM) with a mercury-free ech2o UV lamp that regularly irradiates stored water and tank walls



### Minimal Effort for Maximal Efficiency

This single-system setup supports up to four ergonomic and easy-to-use Q-POD and E-POD dispensers, giving you access to purified water throughout the lab, even on distant benches. The compact purification unit and tank can be stored on the wall or under the counter, leaving benchtops free of clutter for an optimized lab space and a more efficient working environment. Also, the POD's smartphone-like touchscreen interface allows you to view essential system functions with ease.

By integrating powerful data management capabilities, this system simplifies and automates data storage using internal memory, eliminating the need for log books or manual tracking. Reports such as individual dispensing events, daily quality measures and the complete system history can be created and conveniently exported using the POD screen's USB port.

### Less Waste for More Sustainability

As the first and only mercury-free tap-to-ultrapure water system on the market, the

Milli-Q IQ 7003/7005 contains patented ech2o UV lamps to photo-oxidize organic contaminants and control bacteria. These environmentally-friendly lamps are far more compact than those used previously, allowing for a system that's 25 percent smaller overall.

The system's IPAK Quanta purification cartridges are also 33 percent smaller than before. Therefore, less plastic is required for manufacturing and packaging, reducing shipping costs and waste. Other features like online documentation help reduce paper use, while the unique Lab Close mode hibernates the system to reduce water and electricity consumption. The Reverse Osmosis (RO) purification system and its recovery loop optimize water recovery, also minimizing water use.

In the United States, the ech2o Collection and Recycling Program helps reduce the environmental impact of lab water purification cartridges and filters. MilliporeSigma remains the only lab water system provider that offers the option to fully recycle exhausted cartridges and filters, which can help you minimize your waste stream.





## Additional Features for Improved Reliability

- Delivers ultrapure water that is consistently ion free at the sub-ppb level and with low Total Organic Carbon (TOC) levels ( $\leq 2$  to  $\leq 5$  ppb)
- Continuous resistivity measured in-line (0.01cm-1 cell constant and thermistor sensitive to 0.1°C) and displayed on the POD touchscreen

- Equipped with an ech20 mercury-free UV oxidation lamp, recently redesigned for greater accuracy
- Complies with USP and EP suitability tests for range and precision

In October 2018, the Milli-Q IQ 7003/7005 system officially replaced the Milli-Q Integral system, being the first in a new series of pure and ultrapure water systems to include higher flow rates and a range of tank sizes.

Visit [fishersci.com/milli-q](https://fishersci.com/milli-q) or [fishersci.ca/milli-q](https://fishersci.ca/milli-q) to learn more about Milli-Q IQ 7003/7005 Purification Systems.

Content provided by:

**MILLIPORE  
SIGMA**



# Filtered Laboratory Safety Solutions

MYSTAIRE®

Mystaire manufactures fume hoods and laminar flow hoods to provide operator or process protection from toxic fumes, vapors and particulates.



## Latitude Series C Filtered Hood

Latitude Series C Filtered Hoods are designed for safe, effective weighing and containment of particulates and gases.

### Standard Features:

- Safe-T-Zone HEPA filtration technology
- EverSafe microprocessor controller
- Thermally fused polypropylene construction with dark-blue base

Model	Width	Mfr. No.	Cat. No.
Latitude	48 in.	MY-LBE48	15-338-965
Latitude	72 in.	MY-LBE72	15-338-966

## Isola Vue Filtered Chemical Workstation

Isola Series Filtered Workstations provide chemical and particulate containment. Advanced monitoring and control are key components of each Isola Filtered Workstation.

### Standard Features:

- EverSafe III Touch Control with electronic monitoring of face velocity, filter saturation, temperature and humidity with audible and visible alarms
- Polycarbonate construction for 360-degree visibility — excellent for demonstrations
- Solid-state gas detection with three sensitivity set points

Model	Width	Mfr. No.	Cat. No.
Isola Vue	36 in.	MY-ISL36	15-338-900
Isola Vue	48 in.	MY-ISL48	15-338-901
Isola Vue	72 in.	MY-ISL72	15-338-902

Isola filters sold separately; application dependent



## MY-PCR Workstations

Mystaire MY-PCR workstations establish an ISO5 clean work area with timed UV light. MY-PCR workstations create a “personal” clean work zone.

### Standard Features:

- Combines vertical ISO5 air with UV light sterilization
- Safety switch to eliminate UV light exposure
- Polycarbonate construction with polypropylene base

Model	Width	Mfr. No.	Cat. No.
MY-PCR	24 in.	MY-PCR24	15-338-365
MY-PCR	32 in.	MY-PCR32	15-338-366
MY-PCR	48 in.	MY-PCR48	15-338-367

MY-PCR filters included in the purchase price







The market leader for small animal research equipment, providing the best in class technology for:

- Rodent Anesthesia
- Physiological Monitoring
- Surgical Lab Setup Solutions



## Oil-Free, Corrosion Resistant



### KNF LABOPORT Vacuum Pumps

LABOPORT vacuum pumps from KNF Neuberger are the perfect choice for a wide range of laboratory vacuum applications, including rotary evaporation, filtration, desiccation, vacuum ovens, and more. These vacuum pumps are non-contaminating and provide a clean, reliable, environmentally friendly benchtop vacuum source.

- Premium, metal-free, chemical-resistant parts for long product life
- Oil free for clean, maintenance-free performance
- Compact design is portable and quiet



Model	Pump Configuration	Flowrate	Vacuum	Cat. No.
<b>Chemical-Resistant Vacuum Pumps: for Evaporation, Vacuum Ovens, Vacuum Concentration</b>				
UN820.3FTP	2 Stage	20L/min.	6 torr (8mbar)	<b>13-878-27</b>
UN840FTP	Single Stage	34L/min.	75 torr (99mbar)	<b>13-878-44</b>
UN840.3FTP	2 Stage	34L/min.	6 torr (8mbar)	<b>13-878-29</b>
UN842.3FTP	2 Stage	34L/min.	1.5 torr (2mbar)	<b>13-878-35</b>
<b>Mini Vacuum Pumps: for Vacuum Desiccation, Degassing, Solvent Filtration</b>				
UN86KTP		5.5L/min.	120 torr (160mbar)	<b>13-878-38</b>
UN811 KVP		13L/min.	75 torr (100mbar)	<b>13-880-34</b>
UN816.3KTP		16L/min.	15 torr (20mbar)	<b>13-880-30</b>
UN816.1.2KTP		30L/min.	120 torr (160mbar)	<b>13-880-32</b>

# Sustainable Solutions From Nor-Lake® Scientific



## Your Trusted Brand Since 1947

is proud to introduce White Diamond and Black Diamond Series Laboratory Refrigerators & Freezers.

### White Diamond Features

- Microprocessor Temperature Controller
- Superior Temperature Control
- Audio/Visual Hi and Low Temperature Alarm
- Undercounter/Table Top Refrigerators and Freezers
- In Stock, Ready To Ship
- 3 Year Comprehensive P & L Warranty

### Black Diamond Features

- Intuitive Touch Screen Display
- Independent Microprocessor Temperature Controller
- High Performance Refrigeration System
- Data Logging
- Upright Glass and Solid Stainless Steel Door Refrigerators
- 3 Year Comprehensive P & L Warranty



### Intuitive Touch Screen







## New, Updated Capabilities

### OHAUS Pioneer PX Balances

The new OHAUS Pioneer PX line of balances offers affordability and functionality for everyday applications, from parts counting to essential weighing.

- Dual line display for additional guidance or information
- Equipped with RS232 and USB ports for better connectivity
- Choose from analytical, precision, or semi-micro models

Visit [fishersci.com/OHAUSPioneer](http://fishersci.com/OHAUSPioneer) to learn more.



Model	Capacity	Readability	Calibration	Mfr. No.	Cat. No.
<b>Analytical Balances</b>					
PX124/E	120g	0.0001g	External	30429846	<b>01-922-172</b>
PX124			Internal	30429838	<b>01-922-173</b>
<b>Precision Balances</b>					
PX323/E	320g	0.001g	External	30429849	<b>01-922-180</b>
PX323			Internal	30429840	<b>01-922-181</b>
PX1602/E	1600g	0.01g	External	30430058	<b>01-922-190</b>
PX1602			Internal	30430055	<b>01-922-191</b>
PX4202/E	4200g	0.01g	External	30429852	<b>01-922-184</b>
PX4201			Internal	30429844	<b>01-922-189</b>
PX2201/E	2200g	0.1g	External	30430059	<b>01-922-186</b>
PX4201/E	4200g	0.1g	External	30429853	<b>01-922-188</b>

## A New Kind of Biosafety Cabinet

### Labconco Purifier Axiom Biosafety Cabinets

The Axiom Class II, Type C1 is the first of its kind: a biological safety cabinet (BSC) that can be used as either a Type A cabinet (recirculating) for standard microbiological work or a Type B cabinet (connected to an exhaust system) to handle hazardous chemical vapors or radionuclides.

- For handling agents that require Biosafety Level 1, 2, or 3 containment, or BSL 4 with proper PPE
- Chem-Zone work surface: large central work area with staging areas on either side
- More energy efficient than a Type B cabinet
- Easily switch between Type A and B modes of circulation
- Multiple configurations including 10 in. sash height, with base stand, and with or without Accessory Package



Nominal Width	Actual Width	Sash Opening	Includes	Cat. No.
4 ft.	54.2 in. (137.6cm)	10 in.	Base Stand	<b>30-441-0100</b>
6 ft.	78.2 in. (198.6cm)		<b>30-461-0100</b>	
4 ft.	54.2 in. (137.6cm)	10 in.	Base Stand, Accessory Package*	<b>30-441-1100</b>
6 ft.	78.2 in. (198.6cm)		<b>30-461-1100</b>	

\*Accessory Package includes right side-mounted factory-installed service fixture (one on each side for 6 ft. models), UV lamp with timer, and right side-wall Vacu-Pass Portal.

## Lightweight and Versatile



### Heidolph Hei-TORQUE Core Overhead Stirrers

The compact design of Heidolph Hei-TORQUE Core Overhead Stirrers works well in fume hoods, reactors, production systems, and other closed systems.

These stirrers are suitable for low- to medium-viscosity media up to 25L. The large diameter (10mm) chuck lets you use larger impellers and VISCO JET tools for homogenization, dispersion, dissolving agglomerates, and more.

Includes a control knob for rotation speed, with “Max” button for bursts of maximum speed.

- Maximum torque: 40Ncm
- Speed range: 20 to 2,000rpm
- Maximum viscosity: 10,000mPas
- Timer range: 0 to 6,001 minutes



Description	Mfr. No.	Cat. No.
Hei-TORQUE Core Stirrer	036-0900-05	02-321-070

## Self-Adjusting Vacuum



### VACUUBRAND PC3001 VARIO Select Vacuum System

The new VACUUBRAND PC3001 VARIO select Chemistry Vacuum System brings touchscreen control to rotary evaporation, centrifugal concentration, and other vacuum applications.

- Integrated VACUU•SELECT controller with intuitive smartphone-like interface
- Use pre-programmed options or create your own custom routine
- Includes powerful speed-controlled 1.5 Torr, 34 lpm PTFE diaphragm MD1C vacuum pump
- Whisper-quiet operation
- Integrated solvent recovery
- Special introductory price (for a limited time)



Description	Mfr. No.	Cat. No.
PC3001 VARIO select Vacuum System, 100-120V U.S. Plug	20700203	14-380-954PM



# Mycobacteria: Exploring the Life in Your Showerhead

By Kylie Wolfe

Standing in your shower under a steady, warm flow of water, you expect to emerge cleaner than you entered. While that's largely the case, a recent study found that you may be exposed to lung-disease-causing bacteria, known as mycobacteria, in the process. This popular genus lives in the hustle and bustle of your showerhead, making a home in the slime that inevitably lines it.

## Thriving Threats

A study conducted at the University of Colorado Boulder collected 656 samples from households in the United States and 13 countries across Europe to identify the bacterial species present. Researchers used DNA sequencing technology to test each sample, which revealed that mycobacteria are the most abundant genus found in residential showerheads.

Additional analysis showed that these bacteria favor tap water over well water and are more common in the United States than in Europe. The latter trend may be rooted in the regular use of chlorine-based cleaning products in the United States. Since mycobacteria are resistant to chlorine, they may be able to survive the disinfectants better than other bacteria. In Europe, competing bacteria are more likely to survive and may even outcompete these potential pathogens.

## Materials Matter

Researchers found that showerhead materials can also determine where these microorganisms will thrive. The study showed that more mycobacteria are found in metal showerheads than plastic. This is believed to be a result of the chemicals released from plastics. They help support a wider variety of bacteria and may prevent this genus from becoming too abundant.

One can gather that mycobacteria are determined to survive, enduring rapid temperature changes and heavy water flow as

well as periods of inactivity and dryness. But when they become airborne, they can enter your respiratory system, a common mode of transmission for nontuberculous mycobacterial (NTM) lung infections. Since NTM cells are hydrophobic, this may increase the likelihood of aerosolization and inhalation.

## Geographical Correlations

Researchers noticed a relationship between locations where NTM lung diseases are more common (Southern California, Florida and New York) and areas where mycobacteria are abundant. These epicenters of activity may help scientists better understand the ideal conditions for this type of bacteria so that it can one day become less of a threat.

Other studies have shown a genetic match between the strains of mycobacteria recovered from patients with NTM infections and those found in their showers. This raises a public health concern since the disease is difficult to treat and more and more cases are being reported.

## Prospective Paths for the Future

Beyond the differences in disinfectants and showerhead materials, researchers hope to determine the geographical significance of their findings. Without a lab-based test, signs of mycobacteria are mostly unknown to everyday home owners. The hope is that further research will uncover more information about microbial diversity and distribution.

Learning about your showerhead microbiome can help you understand its impact on your health. While most bacteria that make your showerhead their home are harmless, some aren't, and scientists are hoping to find ways to minimize this exposure.

# Purchase 2 Cases of New Axygen® PCR Strip Tubes with Attached Caps and Get 1 Case at No Additional Cost

- Designed to fit a wide variety of thermal cyclers
- Precisely aligned caps prevent evaporation and allow for easy opening and closing
- Strong plastic connections between the tubes prevent separation
- Numbered caps for easy identification
- Available with domed or flat caps



**Purchase any 2 cases of either domed- or flat-cap strip tubes and receive 1 case at no additional cost.**

Cat. No.	Mfr. Cat. No.	Description	Color	Volume	Qty/Pk	Qty/Cs
14-223-607	PCR-0208-AD-C	Thin wall PCR 8-strip tubes with individually attached domed caps	Clear	0.2mL	126	1,260
14-223-985	PCR-0208-AF-C	Thin wall PCR 8-strip tubes with individually attached flat caps	Clear	0.2mL	126	1,260

**Valid from January 1, 2019 to June 30, 2019**

Visit [fishersci.com](http://fishersci.com) or [fishersci.ca](http://fishersci.ca) to **purchase your qualifying products and redeem this promotion.**

**Terms and Conditions:** Offer valid in the U.S. and Canada only and void where prohibited by government, law, or company policy. Offer valid for end-user customers only for purchases from January 1, 2019 to June 30, 2019 or while supply lasts. Redemption information must be received by July 15, 2019. Corning has the right to substitute products if required. Please allow 4 to 6 weeks for delivery. **Redeemed goods limited to 2 cases per lab.**

This promotion is not available to our current or potential healthcare customers. Healthcare customers include any healthcare practitioner, other healthcare provider or any individual or organization authorized to prescribe, dispense, purchase or influence the acquisition or use of medical devices or supplies for clinical use. Healthcare customers include, without limitation, any "Health Care Practitioner" under the Massachusetts Marketing Code of Conduct Law (defined at 105 C.M.R §907.004) or a "Health Care Provider" under the Vermont Prescribed Products Gift Ban and Disclosure Law (defined at Vt. Stat. Ann. tit. 18, §4631a(8)). By participating in this promotion, you warrant that you are not a current or potential healthcare customer. Thermo Fisher Scientific reserves the right to determine your status in the event of a dispute.

For additional product or technical information, visit [fishersci.com/corning](http://fishersci.com/corning), call 1-800-766-7000, or contact your Fisher Scientific representative.

**Warranty/Disclaimer:** Unless otherwise specified, all products are for research use only.



Buy any Invitrogen primary antibody and **save 25%** on a secondary antibody



To save now, go to [fishersci.com/invab25](https://fishersci.com/invab25) and use promo code **INVAB25** (U.S.)

Visit [fishersci.ca/invab25](https://fishersci.ca/invab25) for ordering in Canada

Restrictions may apply.

**ThermoFisher**  
SCIENTIFIC

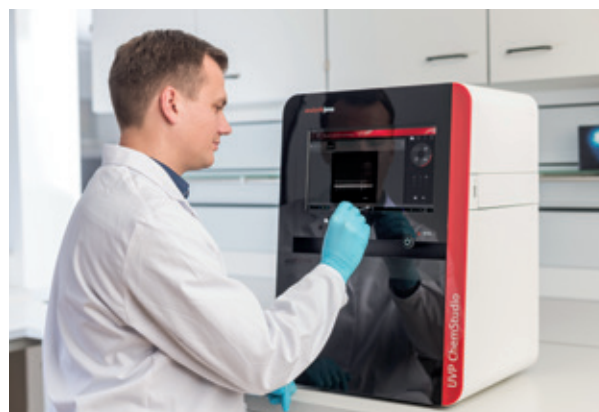
## Get Out of the Darkroom and Into the Studio

**analytikjena**  
An Endress+Hauser Company

Analytik Jena UVP ChemStudio *touch*

For a limited time, all ChemStudio models will be equipped with two-channel NIR and three-channel visible fluorescence at no additional cost to you.

- Small footprint, modular, versatile
- Unmatched sensor sensitivity
- Instant-on cold cathode UV transillumination
- Options for built-in touchscreen or external computer control
- One-touch templates for easy image capture
- Simple, comprehensive analysis, unlimited free software, no proprietary data files
- Three-year warranty



Contact your **Fisher Scientific sales representative** to order.

*Excludes healthcare customers. See page 48 for details.*

Description	Mfr. No.	Cat. No.
ChemStudio <i>touch</i> , 815	SP-1082	<b>SP1082PM</b>
ChemStudio <i>touch</i> , 615	SP-1083	<b>SP1083PM</b>
ChemStudio PLUS <i>touch</i> , 815	SP-1084	<b>SP1084PM</b>



SAFETY





# Nature-Inspired Carbon Capture

By Gina Wynn

Researchers at Tokyo Institute of Technology (Tokyo Tech) in Japan have taken cues from nature to rethink the possibilities for capturing carbon dioxide from the atmosphere to combat its threat to our environment and to public health.

It is no secret that high levels of heat-trapping carbon dioxide in our atmosphere from the burning of fossil fuels like coal, oil and gas are contributing to climate change. For humans, exposure to too much carbon dioxide can result in adverse health effects including shortness of breath, drowsiness, dizziness, headaches, low productivity, and more.

## The Technology

After decades of work, Tokyo Tech chemists have recently found success using a process called electrocatalysis to reduce the amount of carbon dioxide in gases with low carbon dioxide concentrations.

Tokyo Tech's electrocatalytic method eliminates the need for the energy-consuming condensation processes

This work is significant as one of the few projects focused on improving direct capture of carbon dioxide concentrations as low as one percent. Heavy industry exhaust typically contains low levels of carbon dioxide (around 3 to 13 percent). Prior studies aimed to reduce carbon dioxide at higher levels.

## Learning from Nature

The research team, led by Osamu Ishitani from the Department of Chemistry, may have been inspired by how plants have been operating since the beginning of time. Plant respiration is made

possible by repurposing low concentrations of carbon dioxide in the atmosphere (about 400ppm, or 0.04 percent).

The journal *Chemical Science* published the study that details how the team of chemists, which included Hiromu Kumagai and Tetsuya Nishikawa, made a breakthrough with the electrocatalytic process. Electrocatalysis takes energy from one set of electrochemical reactions to accelerate another reaction.

By harnessing the capabilities of a rhenium-based catalyst, they were able to capture low-concentration carbon dioxide in the presence of triethanolamine (TEOA).

## Experimental Success

According to university reports, "In a series of experiments to assess electrocatalytic activity, the researchers found that at a carbon dioxide concentration of 1 percent, the rhenium-based catalyst showed very high selectivity (94 percent) toward carbon monoxide formation."

The team credits the efficient insertion of carbon dioxide into the rhenium-oxygen bond for the experiments' successes. It may have also contributed to the study's most noteworthy outcome: the technology's ability to successfully work with particularly low concentrations of carbon dioxide.

## Future Potential

Tokyo Tech's electrocatalytic method eliminates the need for the energy-consuming condensation processes that are typically necessary for carbon capture. Current methods, like direct air capture, are also costly.

Ishitani and his colleagues hope that a scaled-up version of their electrocatalytic technology could offer a more viable, environmentally friendly option for capturing carbon from the atmosphere — helping to control climate change and making clean air available for future generations.



# PURUS Biohybrid Mats:

## Sustainable and Environmentally Conscious

Choosing an environmentally preferred product can make an enormous difference with limited effort. PURUS recognizes that sustainable business practices are not only in the company's best interest, they also benefit associates, suppliers, customers, and the community. That's why PURUS is committed to helping you achieve your own sustainability goals by providing eco-friendly products.

Environmental concerns may seem difficult to tackle in industrial settings, but they don't have to be. Consumables, the products required for day-to-day processes, are an easy place to start. Depending on the industry, these products may consume a very large part of the budget, but their environmental impact may not be taken into consideration.

### Renewable Resources

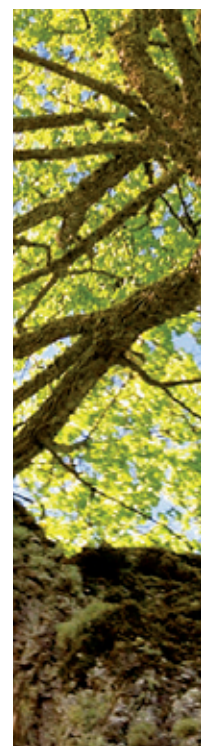
Historically, the tacky mats commonly used in cleanrooms and other controlled environments have been made of 100 percent low-density polyethylene (LDPE) from non-renewable resources. Each mat has consisted of 30 or 60 sheets of 1.5mil film coated with 0.3mil thick acrylic-based, pressure-sensitive adhesive.

Now, PURUS biohybrid mats, produced exclusively by Purus International, Inc., are the first ever contamination control product to contain renewable plant-based materials. They are an environmentally friendly alternative for socially responsible organizations.

"PURUS will eliminate 135 metric tons of CO<sub>2</sub> gas emissions per year with the new process. By comparison, it would take almost 160 acres of forests to sequester that much CO<sub>2</sub> in a year's time."

### Sustainable Choices

To achieve this standard, a special thermoplastic starch (TPS) resin was blended with LDPE to form sheets. The TPS resin, made from renewable, sustainable and GMO-free materials, makes up approximately 20 percent of the biohybrid sheets. The starch sources used also meet specific environmental criteria.



*\*Emissions calculations based on EPA calculations*



## Reducing the Carbon Footprint

Another major benefit of choosing renewable resources is a reduction in the product's overall carbon footprint. The Centre for Design at RMIT University in Melbourne, Australia, performs Life Cycle Analyses (LCA) to determine the amount of greenhouse gases produced to support human activity. Results of an LCA analysis are usually expressed in equivalent tons of carbon dioxide (CO<sub>2</sub>).

An LCA performed for PURUS biohybrid mats indicated that by using the hybrid resin, the company's greenhouse gas emissions were reduced by 11 percent. Further, it estimated PURUS will

eliminate 135 metric tons of CO<sub>2</sub> gas emissions per year with the new process. By comparison, it would take almost 160 acres of forests to sequester that much CO<sub>2</sub> in a year's time\*.

In addition to the described savings, these biohybrid mats further protect the environment with carbon credits used to offset the carbon produced from freight deliveries. By contributing to various forestry, energy-efficiency and renewable-energy projects, PURUS biohybrid mats will offset an additional 140 tons of CO<sub>2</sub> per year, an amount equivalent to the effect of another 165 acres of forests.

## Performance Benefits

Also, PURUS biohybrid mats maintain

the same superior performance as their all-LDPE predecessor. In addition to excellent tensile and elongation properties, the mats meet all of the necessary strength, flexibility and durability requirements desired for the product.

The use of renewable materials and contributions to carbon offsets allows PURUS biohybrid mats to sequester 300 tons of CO<sub>2</sub> emissions annually without sacrificing performance. While environmental initiatives for production can be difficult to manage, these mats offer an easy solution for companies who want to reduce their overall impact.

Content provided by:



# Ready-to-Use Cleaning Solutions

## Decon Peroxigen and CiDehol

Peroxigen is a ready-to-use 6% hydrogen peroxide solution that is safe to use.

- Leaves no residue (breaks down into water and oxygen)
- Low toxicity; non-flammable; zero VOCs
- Use for hard, non-porous surfaces in labs and production areas

CiDehol 70 is 70% IPA (v/v) filtered to 0.2µm and meets USP specifications.

- Evaporates completely — no rinse required
- Use on surfaces and hoods in microbiology and tissue culture labs
- Ideal for pharmaceutical, biotechnology, and medical device facilities



Description	Mfr. No.	Cat. No.	Quantity
Peroxigen Solution, 16 oz. Trigger Spray Bottle	9816	<b>04-355-160</b>	Each 12/Case
CiDehol, 16 oz. Trigger Spray Bottle	8416	<b>04-355-63</b>	Each 12/Case
CiDehol, 32 oz. Trigger Spray Bottle	8432	<b>04-355-250</b>	Each 12/Case
CiDehol, 1 gal. Bottle	8401	<b>04-355-71</b>	Each 4/Case
CiDehol, 5 gal. Bottle	8406	<b>04-355-130</b>	Each
CiDehol, 55 gal. Drum	8405	<b>04-355-42</b>	Each

Note: Both Peroxigen and CiDehol 70 are available as sterile products. Peroxigen ST is packed in a case of 12 x 16 oz. trigger spray bottles and CiDehol ST is packed in a case of 12 x 16 oz. trigger spray bottles, 12 x 32 oz. trigger spray bottles, or 4 x 1 gal. bottles. Sterile products are gamma-irradiated to SAL 10<sup>-6</sup> and tested for sterility. Each case is shipped with a lot-specific document detailing QC parameters, irradiation, endotoxin, and sterility testing.





# Protect Your People from Workplace Hazards

## **Chemical Handling and Management**

Providing the right safety products for your employees is essential. The Fisher Scientific channel offers a comprehensive selection of products categorized for easy ordering, including PPE, emergency response, label makers and signs, and hazardous material storage and containment solutions that can help you create and maintain a safe work environment.

Visit [fishersci.com/chemicalhandling](https://fishersci.com/chemicalhandling) to learn more and download the brochure.



300 Industry Drive  
Pittsburgh, PA 15275



# Order Your Fisher Scientific PPE Catalog

## Protecting What Matters Most

Shop the products you need to protect your workers — all in one place — with the new Fisher Scientific Personal Protective Equipment Catalog.

Visit [fishersci.com/ppcatalog](https://fishersci.com/ppcatalog) to order your copy.

### Promotion Terms and Conditions

These promotions are not available to our current or potential healthcare customers. Healthcare customers include any healthcare practitioner, other healthcare provider or any individual or organization authorized to prescribe, dispense, purchase or influence the acquisition or use of medical devices or supplies for clinical use. Healthcare customers include, without limitation, any "Health Care Practitioner" under the Massachusetts Marketing Code of Conduct Law (defined at 105 C.M.R. §907.004) or a "Health Care Provider" under the Vermont Prescribed Products Gift Ban and Disclosure Law (defined at Vt. Stat. Ann. tit. 18, §4631a(8)). By participating in any of these promotions, you warrant that you are not a current or potential healthcare customer. Thermo Fisher Scientific reserves the right to determine your status in the event of a dispute.

Customer acknowledges that these offers may include a discount or other price reduction that must be properly and accurately accounted for and reported by customer in accordance with all federal and state laws, including without limitation the federal anti-kickback law (42 U.S.C. § 1320a-7b(b)(3)(A)) and regulations thereunder (42 C.F.R. §1001.952(h)).

The factual representations regarding the products accurately reflect the manufacturers' representations to Fisher Scientific. To the extent permissible, Fisher Scientific will make available to its customers the manufacturers' warranties. The sole and exclusive liability of Fisher Scientific shall be refund of the purchase price or replacement of the product. In no event shall Fisher Scientific be liable for incidental or consequential damages. **FISHER SCIENTIFIC EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.** Prices may change without notice. Prices are U.S. list prices — pricing may vary in Canada. Content and printed prices subject to confirmation by your Fisher Scientific Sales Representative. Telephone calls may be monitored as part of Fisher Scientific's quality process.

© 2019 Thermo Fisher Scientific Inc.  
All rights reserved.  
Trademarks used are owned as indicated at [fishersci.com/trademarks](https://fishersci.com/trademarks).  
Litho in U.S.A. 18-196-2313 12/18  
BN20182392