

# LAB REPORTER

Innovative Products and Science News  
NO. 2, 2018

## THE FUTURE OF FOOD: SUSTAINABLE FARMING IN THE CITY

Also in This Issue:  
The Plastic Problem  
Green Initiatives in Brewing  
Turning Trash into Technology  
Genetically Modified Yeast

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# THE PLASTIC PROBLEM: RECYCLING PRODUCTS BUILT TO LAST

By Rita Waimer

Plastics are all around us, used to make a wide variety of products from disposable packaging and reusable bottles to pens, pencils, eating utensils, pipes, car parts, toys, office supplies and much more. The material is chosen because it's so versatile — it can be molded into just about anything — and it's durable enough to withstand the test of time. The downside is that those same qualities make it difficult to recycle.

According to a study published by the National Institutes of Health, one major hurdle to recycling plastics is that “most different plastic types are not compatible with each other because of inherent immiscibility at the molecular level” — like oil and water, they simply don't mix. For example, polyvinyl chloride (PVC) included in a polyethylene terephthalate (PET) recycle stream will release hydrochloric acid gas because it melts at a lower temperature than PET, thus degrading the recycled PET resin. Conversely, PET included in a PVC recycle stream will form clumps and reduce the value of the recycled material. Basically,

recycling plastic materials requires a lot of effort and energy, and the end product is frequently of a lower quality than brand new plastic.

That's why researchers are now working on ways to more efficiently recycle plastics and develop plastics that are easier to recycle.

## The Future of Recycling Plastic

To make recycling easier, researchers are focused on finding compatibilizers, substances that help various types of plastics mix, allowing them to be recycled together. The ideal compatibilizer would work with all polymers, but current technology requires a tailored approach for each mixture. Additionally, researchers are trying to develop a way to recycle polymers like thermosets and rubber materials that can't be melted down and recycled by traditional means. With both of these methods, researchers must ensure that the quality of the recycled materials remains unaffected.

At the University of Houston, associate professor of chemical and biomolecular engineering Megan Robertson, is working to create biorenewable components for thermosets. She and her team are trying to make polymers using vegetable oils and other plant-based materials instead of hydrocarbons, which would allow the plastics to be composted or chemically recycled.

Presently, 150 million pounds of plastic products are made every year and very few of them are recycled. Around 30 percent of plastics are recycled in Europe, but that figure is less than nine percent in the United States. Instead, those materials go to landfills, and unfortunately, some end up in our oceans and elsewhere. Whether the final solution to this plastic problem is a new method of production, a more efficient method of recycling, or some combination of both, researchers hope that it will lead to increased recycling rates.




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# GREENER CHEMICAL SOLUTIONS FOR YOUR LABORATORY

The concept of green chemistry includes a number of principles that allow for greater sustainability and limit the environmental impact of chemical processes.

Despite the challenges involved in meeting these principles, we have a range of customer solutions within our laboratory chemicals portfolio that help to maximize efficiency while minimizing the hazardous effects on human health and the environment.



## Alternative Solvents and Auxiliaries

Description	Quantity	Cat. No.
<b>Acros Organics Products</b>		
Cyclopentyl Methyl Ether, 99.5%, Extra Dry, Stabilized, AcroSeal Packaging	100mL, 1L	<b>AC39725</b>
Cyclopentyl Methyl Ether, 99+%, Extra Pure, Stabilized	50mL, 250mL, 1L, 2.5L	<b>AC39613</b>
2-Methyltetrahydrofuran, 99+%, Extra Dry, Stabilized, AcroSeal Packaging	100mL, 1L, 2.5L	<b>AC39662</b>
2-Methyltetrahydrofuran, 99+%, Extra Dry over Molecular Sieve, Stabilized, AcroSeal Packaging	100mL, 1L	<b>AC36993</b>
2-Methyltetrahydrofuran, Anhydrous, Stabilized, For Grignard Reactions	250mL, 1L, 2.5L, 10L	<b>AC39238</b>
<b>Fisher Chemical Products</b>		
Ethyl Acetate Ethanol 3:1 Solution, Optima Grade	1L, 4L	<b>E151</b>

## Alfa Aesar Catalysts

Description	Quantity	Cat. No.
Hydrogen Tetrachloroaurate(III) Trihydrate, 99.99% (Metals Basis), Au 49.0% Min., ACS Grade	1g, 5g	<b>AA36400</b>
Palladium(II) Chloride, 99.9% (Metals Basis), Pd 59.0% Min.	500mg, 2g, 10g, 50g	<b>AA11034</b>
Palladium Hydroxide, Pd 20% on Carbon, Nominally 50% Water, Pearlman's Catalyst	2g, 10g, 50g	<b>AA42578</b>
Tetrakis(Triphenylphosphine)Palladium(0), 99.8% (Metals Basis), Pd 9% Min.	500mg, 2g, 10g	<b>AA10548</b>
Palladium(II) Nitrate Hydrate, 99.8% (Metals Basis), Pd 39% Min.	2g, 10g, 50g	<b>AA11035</b>
Silver Trifluoromethanesulfonate, 98%	2g, 10g, 50g	<b>AA88722</b>

## Solutions for Waste Prevention

Choice is at the heart of what we offer. Most products are available in a range of packaging options to help customers reduce the waste created from using multiple small packs or the need to dispose of unwanted material from larger packs. For air- and moisture-sensitive chemicals or very reactive products, our industry-leading AcroSeal packaging system protects product integrity so that less unused chemical is discarded. Visit [fishersci.com/acroseal](http://fishersci.com/acroseal) for more information.

## Reducing Non-Recyclable Packaging Materials

The Styrofoam-free EcoSafPak is made by a manufacturer certified by the Sustainable Forestry Initiative (SFI). EcoSafPak packaging uses hexacomb design inserts to minimize the use of non-recyclable materials. These revolutionary inserts ensure that the outer package is not only sturdy and durable, but also fully recyclable. Select cases of glass bottles of Fisher Chemical products (4 × 4L, 1 × 4L, 6 × 1L, 6 × 500mL, 1 × 2.5L, 1 × 1L, 1 × 500mL, 2 × 4L, 2 × 1L and 2 × 500mL) are delivered in EcoSafPak cartons. Visit [fishersci.com/ecosafpak](http://fishersci.com/ecosafpak) for more information.



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Almost 200 lb. of glass, cardboard and foam inserts are eliminated by each 200L FisherPak Container



## Reduce Reliance on Glass

The FisherPak® Solvent Delivery System is an ideal choice when working with large quantities of high-purity solvents. It can be used to deliver solvents with enhanced safety, improved productivity and reduced environmental impact, from labs to production volumes.

The system can also reduce the amount of solid waste generated in your laboratory: a reusable 200L FisherPak container replaces 50 four-liter bottles and associated packing material. The sealed delivery system also ensures that flammable or toxic solvent liquids and vapors are not released into the environment. And the empty FisherPak containers are cleaned and refilled by the Fisher Scientific team, meaning no more on-site bottle rinsing.

Each FisherPak Solvent Delivery System is configured to meet the unique requirements of the laboratory. A Fisher Scientific Sales Representative will help you to determine the optimal container fleet size and accessories needed, including:

- The types of chemicals required
- The expected annual usage of each chemical
- Other site-specific requirements

Contact your Fisher Scientific Sales Representative to schedule an initial discussion or visit [fishersci.com/fisherpak](http://fishersci.com/fisherpak) to learn more. Most solvents/blends are available upon request.

\*For United States customers only, where applicable.

1. Taygerly, J. P.; Miller, L. M.; Yee, A.; Peterson, E. A., A convenient guide to help select replacement solvents for dichloromethane in chromatography. *Green Chem.* 2014, 14, (11), 3020-3025.

2. MacMillan, D.S.; Murry, J., et al, Replacement of dichloromethane with chromatographic purification: a guide to alternative solvents. *Green Chem.* et al. 2012, 14, 3016.

## Alternative Solvents and Auxiliaries

Less environmentally damaging chemical alternatives such as 2-Methyl tetrahydrofuran (2-MeTHF) and cyclopentyl methyl ether (CPME) offer alternatives to solvents like tetrahydrofuran (THF); they do not form peroxides and are not miscible with water, so they reduce the volumes of waste water and waste solvents.

2-MeTHF and CPME are both available as neat solvents and combined with a range of common reagents in premade solutions. They are also offered in AcroSeal packaging to further reduce waste potential.

Alternatives to methylene chloride/methanol binary eluents and other chlorinated solvents for chromatography applications are also available in the Fisher Chemical offering. A replacement for dichloromethane, used for flash and normal phase chromatography, is available in Optima Grade Ethyl Acetate Ethanol 3:1 Solution. Studies have demonstrated that binary eluents of ethyl acetate and alcohols are suitable chromatography substitutes.<sup>1,2</sup>



AcroSeal packaging keeps solvents and reagents drier for longer.

## Ionic Liquids

As replacements for organic solvents, ionic liquids benefit from excellent solvating properties, have no measurable vapor pressure and are non-flammable, offering a greener and safer alternative. The Alfa Aesar and Acros Organics portfolios have a range of ionic liquids, including imidazolium, pyridinium, ammonium, and pyrrolidinium ionic liquids.

## Catalysis

The use of catalysts enables increased selectivity, minimized waste, reduced reaction times, and therefore saves energy. The Alfa Aesar product offering includes a full range of catalysts, precious metal salts and solutions that are manufactured to stringent specifications and available in a range of purities and concentrations.

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## Supporting Our Customers

Through our packaging options, product portfolio and choice of sizes that suit your usage requirements, we support your efforts to maximize efficiency and minimize the hazardous effects on human health and the environment.

If you do not find the products that you need, our Specialized Chemical Services may be able to fulfill your requirements. Please contact your Fisher Scientific Sales Representative or visit [fishersci.com/scs](http://fishersci.com/scs) for more information about our products and services.

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# STANDARDS

## UNDERSTANDING THE NEW ISO ACCREDITATION

Laboratories around the world process and analyze hundreds of thousands of samples each day, but the results could cause health, safety and economic risks without an assurance of testing competency and accuracy.

The International Organization for Standardization (ISO) has been one of the world's largest sources of voluntary international standards for manufactured, agricultural and technological products and services since the 1940s.

In the 1990s, ISO expanded its standards to laboratories and producers of reference materials who pursue ISO accreditation. The standard for laboratory and reference materials has recently been updated, and SPEX CertiPrep has developed these answers to common questions about ISO accreditation and how the recent updates may affect you.

### What is accreditation?

Accreditation is the confirmation of the competence of a testing or calibration laboratory or reference material (RM) producer. Accreditation is typically performed by an unbiased independent third party (or accreditation body) that measures to an ISO international standard.

### How do we become an accredited laboratory or reference material producer?

- Complete and submit an application for accreditation to a third-party accreditation body for a particular ISO standard
- Undergo the necessary competency evaluations, including a technical review of procedures, periodic on-site audits, and the results from proficiency testing
- Review the deficiencies report and make the necessary corrections to receive accreditation

### What is ISO/IEC 17025?

ISO/IEC 17025:2017 is the standard for the "General Requirements for the Competence of Testing and Calibration Laboratories." Originally issued in 1999, it was released again in 2005 with five new elements: scope, normative references, terms and definitions, management requirements, and technical requirements.

The management requirement section relates to the laboratory's quality management system. The technical requirements section addresses the reliability of tests, products and calibrations, including accuracy, precision, stability, homogeneity, traceability and uncertainty.





## How are accuracy, precision, stability, homogeneity, traceability and uncertainty defined?

- Accuracy is the degree to which a result or measurement reflects the true value of the result; precision measures how closely repeated measurements agree
- Stability is a state of non-reactivity during normal use; unstable materials may corrode, decompose, polymerize, burn or explode under normal conditions or during use
- Homogeneity is the quality of uniform composition or character; for reference materials, these can be in-bottle or between-bottle or lot
- Traceability is the tracking and documentation of the product or service from the point of origin, through manufacturing/service, and to the final analysis, delivery and receipt
- Uncertainty is the confidence that the true value lies within a specific range of values; uncertainty includes random variables (changes in temperature, humidity, drift), instrument/analyst variability, and homogeneity factors (changes due to storage and/or transportation conditions) and any other variables

Note: Uncertainty is not the same thing as an error or mistake.

## What are the main differences between ISO/IEC 17025:2005 and ISO/IEC 17025:2017?

Many of the changes close verbal loopholes which allowed for different interpretations, including:

- The range and scope of laboratory activities
- Use of certified reference materials and traceability
- Increased periodic reviews and controls for environmental conditions (laboratory access and contamination)

- Definition of equipment that includes instruments, software, data, standards, reference materials (RM), reagents, consumables and other apparatus
- Use of statistical methods (control charts, stability charts, uncertainty calculations)
- Emphasis on impartiality and confidentiality
- Definitions and documentation of staff competency
- Records of staff and personnel supervision and monitoring
- Risk-based management reviews

## What do these changes mean for users?

1. Laboratories operating under ISO 17025 must now provide much more documentation regarding risk analysis and security
2. Laboratories must prove accuracy, precision and competency data based on certified reference materials provided by accredited reference materials providers
3. Companies that produce reference material have to provide more detailed information regarding use, storage and stability, including instructions for maintaining the certified values of the standards during normal use and within the product's stated timeframe

## What is the current version and how are changes made to ISO/IEC 17025?

The latest version was released on November 30, 2017.

ISO/IEC member bodies nominate industry experts to evaluate the need for revisions. Changes are based on the examination of common terminology and structure of other standards, web-based user surveys, collected support and guidance notes, suggestions for new quality concepts, and other recommendations.

## What is Guide 34 and how does it relate to ISO/IEC 17034?

Guide 34 was originally drafted by ISO/REMCO in 1991 and published in 1996 as the "General requirements for the competence of reference material producers". It required demonstrations of scientific and technical competence, the provision of certified values, and supplementary information about reference materials, including traceability, uncertainty, preparation, and methods of measure. Updated in 2009, it was changed to standard ISO/IEC 17034 in 2016.

## What are the differences between Guide 34 and ISO/IEC 17034?

ISO 17034 includes references to ISO 17025 (previously discussed), ISO Guide 31: Reference Materials – General and statistical principles for certification, and ISO/TR 16476: Establishing and expressing metrological traceability of quantity values assigned to reference materials.

In addition to wording/terminology enhancements, the accuracy and stability of reference materials is addressed:

- Reference material identity verification
- Storage and use guidelines to maintain material stability
- Indication of secondary parameters (temperature, humidity) that may influence the traceability or uncertainty of certified values
- Instructions for maintaining material stability, including repeated use or sampling
- Identification of uncertainty contributions

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# Chemicals for the Lab, Field or Production Floor



## RICCA Chemicals

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- National Institute of Standards and Technology traceability
- Custom capabilities to suit your needs



Description	Cat. No.	Quantity	Price
Water for LC/MS, LC/MS Grade	R91540004C	4L	\$96.33
Acetonitrile, HPLC Grade	RS0A00204C	4L	\$331.18
HydroSpec Composit T5, for General Use for One-Component Volumetric KF Titrations	RK2000001C	1L	\$113.50
VeriSpec Aluminum Standard for ICP, 10g/L in 5% HCl*	RV010364250	250mL	\$331.65
Water, Purified, USP/EP Grade	9190-5	20L	\$192.70
Sodium Chloride, 0.9% (w/v), in Water (Isotonic Saline)	7210-1	4L	\$50.00
Sodium Hydroxide, 1.00N, Volumetric Solution, ACS Grade, USP Grade	7450-32	4 x 4L/Case	\$154.80
Silver Nitrate, 0.100N	70001	1L	\$29.60
ProteoSpec Formic Acid Ampules, LC/MS Grade	RMB11202101	4L	\$386.50
Hydrochloric Acid, 1.00N	RMB11202101	10mL	\$91.55
	3700-5	20L	\$160.60

\*ISO 17025/Guide 34

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## Hamilton PRP-C18 Reversed-Phase HPLC Columns

Hamilton PRP-C18 Reversed-Phase Columns are ideal for applications that require method conditions beyond silica column capabilities. Useful for general purpose HPLC, they are especially well suited for specialized applications in the clinical, pharmaceutical, environmental, food, forensics, and life sciences industries.

### Advantages of polymer-based HPLC columns include:

- Longer column life
- Wide pH range stability (pH 0 to 14)
- Compatibility with more solvents
- Higher temperature operating range (up to 100°C)



### PRP-C18 Reversed-Phase Columns

Diameter	Length	Particle Size	Mfr. No.	Cat. No.	Price
2.1mm	50mm	5µm	79672	13-622-100	\$431.82
2.1mm	150mm	5µm	79673	13-622-102	\$547.04
2.1mm	250mm	5µm	79674	13-622-104	\$649.00
4.6mm	50mm	5µm	79675	13-622-106	\$423.53
4.6mm	150mm	5µm	79676	13-622-250	\$577.00
4.6mm	250mm	5µm	79677	13-622-110	\$702.00
21.2mm	250mm	12 to 20µm	79678	13-622-112	\$2,477.58



# CRAFT BREWERIES HOPPED UP ON GREEN INITIATIVES

By Christina Phillis

Craft brewers are known for their creative flair when it comes to marketing and dreaming up new flavors of beer, and now, they are flexing that inventive muscle in a whole new way. From recycling the byproducts of the brewing process to changing beer packaging, craft brewers are creating new, innovative ways to go green.

## Cans Versus Bottles

Some people have a strong preference for the vessel in which their beer is served. But in a world where we need to be conscious of the effects our waste has on the environment, many brewers are switching to cans for some of their product lines. Founders Brewing Company of Grand Rapids, Michigan and, just recently, New Holland Brewing Company of Holland, Michigan, have shifted some, if not most, of their beer to cans. "The real advantage with cans is that they're recycled more," said Founders chief production officer Brad Stevenson.

## Recycled Carbon

Using a carbon recycling system developed and installed by CoBrew, LoLo Peak Brewery was able to create a beer made almost completely out of recycled carbon. It works by filtering and bottling collected carbon dioxide released during the fermentation process. That recycled carbon dioxide can be used for a variety

of purposes, including cleaning bottles and adding bubbles to the beer. And the amount of carbon dioxide they are stopping from entering the atmosphere is "... equivalent to what 250 cars emit a day," said Taylor Woods, founder of CoBrew.

## Conserving Water

High water consumption has always been an Achilles heel for brewers trying to be sustainable. In a 2009 study, the World Wildlife Fund found that the end-to-end beer-making process uses 11 to 40 gallons of water to brew just one gallon of beer. To combat this issue, breweries have been developing a variety of solutions. Full Sail Brewing Company's hot-water recovery system saves more than 3 million gallons of water a year by reusing leftover hot water, Lagunitas Brewing Company uses an EcoVolt Membrane Bioreactor to remove up to 90 percent of its wastewater is pollutants, allowing them to expand the reuse of their water on-site.

## Solar Panels

Some breweries are looking to the sun for their power. Thor Cheston, founder of Right Proper Brewing in Washington, D.C., had solar panels installed on the roof of their building. They predict that 75 to 85 percent of their consumed electricity will eventually come from solar power. And, they can sell their energy credits in the summer months when their energy creation becomes larger than their consumption, making it an even more compelling solution.

The avenues for pursuing sustainability initiatives in the brewing industry seem as intricate and nuanced as the beers being produced by these green innovators, and that is a recipe for success that everyone can get behind.



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# High-Temperature Closures



## DURAN Original GL 45 Laboratory Bottles

DURAN Original GL 45 Laboratory Bottles come with high-temperature screw caps and pouring rings. The polybutylene terephthalate (PBT) caps and ethylene tetrafluoroethylene (ETFE) pouring rings offer greater thermal and chemical resistance than the equivalent polypropylene (PP) components.

### Features

- Clear DURAN borosilicate 3.3 glass USP/EP Type 1; excellent thermal performance, high chemical resistance
- Sizes from 100mL to 10L
- Permanent Retrace Code on bottles for full manufacturing lot traceability
- All components can be autoclaved at 121 to 134°C
- Supplied with red PBT GL 45 threaded cap, PTFE-faced silicone liner and ETFE pouring ring
- PBT caps have 30 percent glass fiber reinforcement to increase stiffness, tensile strength and impact resistance

### Applications

- Sterilizing (autoclaving) liquid media
- Storing corrosive reagents
- Sampling



Capacity	Dia. x H	Mfr. No.	Cat. No.	Quantity	Price
100mL	56 x 105mm	218012417	<b>09-841-300</b>	10/Pack	\$108.15
250mL	70 x 143mm	218013619	<b>09-841-301</b>	10/Pack	\$124.90
500mL	86 x 181mm	218014418	<b>09-841-302</b>	10/Pack	\$156.20
1000mL	101 x 230mm	218015414	<b>09-841-303</b>	10/Pack	\$222.60
2000mL	136 x 265mm	218016316	<b>09-841-304</b>	10/Pack	\$516.80
5000mL	182 x 335mm	218017312	<b>09-841-305</b>	1/Pack	\$217.40
10000mL	227 x 415mm	218018617	<b>09-841-306</b>	1/Pack	\$412.75

# Secure Your Bottles with a Gas-Tight Seal



## Duran GL 45 Bottle Closures

Duran GL 45 Bottle Closures can be used with any GL 45 bottle and are manufactured using polybutylene terephthalate (PBT) with bromobutyl rubber to provide a gas-tight seal. Bromobutyl, or "butyl" rubber, is essentially impermeable to most gases, which helps to provide an in-bottle controlled environment for oxygen-sensitive materials or anaerobic cultures. Used in applications requiring gas purging or sample transfer via a syringe, the 34mm cap opening exposes the butyl-rubber stopper that allows for multiple syringe punctures.

### Duran GL 45 Bottle Closure features include:

- Polybutylene terephthalate (PBT) screw caps
- High-purity bromobutyl rubber elastomer stopper; virtually free of leachable organics
- Fits DURAN GL 45 bottles (sizes from 100 to 20,000mL)
- Meets EP 3.2.9 Type I closures for chemical and penetration tests



Capacity	Mfr. No.	Cat. No.	Quantity	Price
DURAN Rubber Stoppers, Straight Plugs, Gray	292062803	<b>09-841-311</b>	10/Case	\$22.60
DURAN Screw Caps, Red PBT, Central Aperture: 34mm	292271007	<b>09-841-256</b>	10/Pack	\$70.07

# Certified Environmentally Safe Thermometers in Partial or Total Immersion



## Enviro-Safe General-Purpose Liquid-In-Glass Thermometers

- Meet government, education, and industry mandates to purchase “Green” products
- Non-toxic, biodegradable, Enviro-Safe liquid
- Traceable to NIST
- Include a multi-language Statement of Accuracy and Traceability

Range	Divisions	Accuracy	Length	Immersion	Cat. No.	Price
-10/110°C	1°C	±1°C	200mm (7.9")	50mm (2")	13-202-554	\$19.00
-10/150°C	1°C	±1°C, ±1.5°C above 100°C	200mm (7.9")	50mm (2")	13-202-555	\$20.00
-10/260°C	1°C	±1.5°C, ±2°C above 100°C, ±2.5°C above 200°C, ±3°C above 230°C	350mm (14")	76mm (3")	13-202-562	\$30.00
-20/150°C	1°C	±1°C, ±1.5°C above 100°C	300mm (12")	76mm (3")	13-202-559	\$20.00
-20/110°C	1°C	±1°C	300mm (12")	Total Immersion	13-202-568	\$18.00
-10/110°C	1°C	±1°C	200mm (7.9")	Total Immersion	13-202-564	\$20.00
-10/225°C	1°C	±1.5°C, ±2°C above 100°C, ±2.5°C above 200°C	350mm (14")	Total Immersion	13-202-572	\$29.00

For more information and additional selections,  
please visit [fishersci.com](http://fishersci.com) and search keyword: Enviro-Safe General.

## Calibration services available!

[fishersci.com/calibrationservices](http://fishersci.com/calibrationservices)





CORNING

# Survival of the coolest.



Are you looking for a proven way to keep your samples safe while ensuring standardized, controlled-rate freezing? Then take a closer look at Corning CoolCell, an alcohol-free freezing container that delivers uniform cell freezing with high reproducibility.

CoolCell is easy to use with no messy IPA changes and has demonstrated high post-thaw recovery and viability for a wide variety of cell types. No matter what your application or working style, Corning delivers a colorful way to keep your cool.

Visit [fishersci.com/corningcoolcell](https://fishersci.com/corningcoolcell) or contact your Fisher Scientific Sales Representative to learn more.



# Bring the Simplicity of Crossflow to Your Lab



## Sartorius Vivaflow Protein Concentration Systems

The Sartorius Vivaflow 50, 50R, and 200 Systems are the only true laboratory crossflow devices on the market. Use Vivaflow Cassettes in series or parallel for increased throughput. Cassettes help to minimize hands-on time and are available in reusable or disposable formats. Pair these systems with any standard laboratory peristaltic pump at a flow rate between 200 and 400mL/minute for the best results.

### Use for:

- Protein recovery and concentration
- Desalting or diafiltering protein solutions or buffer exchange
- Concentrating viruses from cell culture supernatants (nanoparticle concentration)



Description	Includes	Mfr. No.	Cat. No.	Price
Vivaflow 50 Complete System	<ul style="list-style-type: none"> <li>• Pump (115V)</li> <li>• Easy-load pump head (size 16)</li> <li>• Tubing</li> <li>• Sample diafiltration reservoir (500mL)</li> <li>• Module stand pressure indicator</li> <li>• T connectors</li> <li>• Series interconnectors</li> </ul>	VFS504	<b>14-558-341</b>	\$2,511.67
	Use with	Vivaflow 50R Crossflow Cassettes – Hydrosart Membrane Vivaflow 50 Crossflow Cassettes – Polyethersulfone (PES) Membrane		
Vivaflow 200 Complete System	<ul style="list-style-type: none"> <li>• Pump (115V)</li> <li>• Easy-load pump head (Size 16)</li> <li>• Tubing</li> <li>• Sample diafiltration reservoir (500mL)</li> </ul>	VFS504	<b>14-558-340</b>	\$2,041.52
	Use with	Vivaflow 200 Crossflow Cassettes – Hydrosart Membrane Vivaflow 200 Crossflow Cassettes – Polyethersulfone (PES) Membrane		



Contact your Fisher Scientific Sales Representative for further details.

# Keep It Cold, On the Go



## Sonoco ThermoSafe Insulated Storage and Transport Chests

ThermoSafe Storage and Transport Chests provide mobile, nonelectrical temperature maintenance for a wide variety of laboratory and field applications that require dry ice and wet ice storage, short-term frozen storage, hot storage, field collection, and cryogenic testing. Ideal for demanding cryogenic and laboratory testing situations and during transport and storage of temperature-sensitive specimens, models are available with rugged polyethylene interiors\* and exterior casings or lightweight laminated fiberboard with EPS foam interiors.

### Features include:

- Efficient, non-deteriorating polyurethane foam insulation
- Rounded interior corners for easy cleanup
- Detachable lid (Model 1167613) that is useful for storing dry ice at the benchtop

\*Polyethylene casing with urethane foam insulation, R-value: 6.2 per inch [1.1Km2/W]





# Use As an Alternative to Quartz

## BRAND UV-Transparent Disposable Cuvettes

BRAND UV-Transparent Disposable Cuvettes from BrandTech Scientific are a popular, disposable alternative to quartz spectrophotometry cuvettes.

### Features and Benefits:

- Suitable for DNA, RNA, and protein analysis, and applications read at wavelengths between 230 and 900nm
- Eliminate washing, cross-contamination, breakage, and the higher cost of quartz cuvettes
- Proprietary material that offers superior chemical compatibility compared to conventional plastic cuvettes
- Choice of individually wrapped cuvettes for extra sample protection
- Additional options include PS, PMMA, and four-sided, clear fluorimetry cuvettes



Description	Capacity	Mfr. No.	Cat. No.	Quantity	Price
Macro Cuvettes	2.5 to 4.5mL	759170	<b>14-377-009</b>	100/Pack	\$131.00
Semi-Micro Cuvettes	1.5 to 3mL	759150	<b>13-688-74</b>	100/Pack	\$131.00
		759165	<b>13-688-73</b>	500/Pack	\$577.00
Ultra-Micro Cuvettes, 8.5mm Window	70 to 850µL	759200	<b>13-878-121</b>	100/Pack	\$131.00
		759210	<b>13-878-122</b>	500/Pack	\$577.00
Ultra-Micro Cuvettes, 8.5mm Window, Individually Wrapped		759215	<b>03-840-300</b>	100/Pack	\$199.00
Ultra-Micro Cuvettes, 15mm Window	70 to 550µL	759220	<b>13-878-123</b>	100/Pack	\$131.00
		759230	<b>13-878-124</b>	500/Pack	\$577.00
Ultra-Micro Cuvettes, 15mm Window, Individually Wrapped		759235	<b>03-840-301</b>	100/Pack	\$199.00

# Comfortable, High-Performance Pipettes

## BRAND Transferpette S Pipettes

BRAND Transferpette S Single-Channel and Multichannel Adjustable Pipettes from BrandTech Scientific offer excellent performance, comfort, and value. Constructed of innovative composite materials, lightweight Transferpette S Pipettes are autoclavable and can be operated completely with one hand. The four-digit display provides precise, easy-to-read volume settings, and is always visible during pipetting.

### Additional features:

- Adjustable and fixed-volume single-channel options available in sizes from 0.1µL to 10mL
- Multichannel options available in sizes from 0.5-300µ
- Thumb-tip volume selection lets you set and secure the volume without shifting your hand position
- Lightweight body and a short pipetting stroke reduce the risk of repetitive strain injury
- Compatible with tips from most manufacturers

All Transferpette S Pipettes are supplied with a performance certificate, operating manual, shelf mount, and three-year warranty.



### Single Channel Adjustable Pipettes\*

Capacity	Mfr. No.	Cat. No.	Price
0.1 to 1µL	704768	<b>03-837-317</b>	\$487.49
0.1 to 2.5µL	704769	<b>13-689-204</b>	\$405.69
0.5 to 10µL	704770	<b>03-837-318</b>	\$454.10
2 to 20µL	704772	<b>03-837-319</b>	\$446.87
10 to 100µL	704774	<b>03-837-320</b>	\$454.10
20 to 200µL	704778	<b>03-837-321</b>	\$454.10
100 to 1000µL	704780	<b>03-837-322</b>	\$446.87
0.5 to 5mL	704782	<b>03-837-323</b>	\$446.87
1 to 10mL	704784	<b>03-837-325</b>	\$454.10

\*See fishersci.com for multichannel and fixed-volume models.



# THE FUTURE OF FOOD: SUSTAINABLE FARMING IN THE CITY

By Mike Howie

Growing and delivering fresh food is environmentally expensive. Traditionally, a farm requires acres of land and hundreds of gallons of water to grow anything. And once the food is harvested, it has to be shipped to consumers who are sometimes thousands of miles away. But, as innovative farmers are proving, this doesn't have to be the case. Fresh food can be grown with less space and fewer resources, and it can be done in the middle of the city.

## Growing Greens in Brooklyn

In a Brooklyn, New York parking lot, an indoor farming accelerator called Square Roots repurposes shipping containers as farms to grow up to 50 pounds of leafy greens per week with just eight gallons of water per day. That's as much food as a two-acre farm produces in a year, but it uses 95 percent less water and no soil.

Inside each of the climate-controlled, 320-square-foot containers, farmers grow a variety of foods using high-tech methods. Instead of growing up from the ground, plants grow out from the side of special racks that hang from the ceiling. Water drips through an irrigation system, mixes with a selection of nutrients, and is then fed by gravity over the roots of the plants.

The water is collected at the bottom and recycled through the farm. And instead of sunlight, the plants bask in the glow of pink LED lights — chosen because plants need only the red and blue spectrum of light to grow.

In addition to taking a new approach to farming, Square Roots also rethinks who farmers are. Through their 13-month Resident Entrepreneur Program, 10 individuals run the 10 containers while participating in skill-based training, professional development and experiential learning. These entrepreneurs operate their farms as businesses, growing and then delivering food to customers around the city. For their efforts, the entrepreneurs receive 30 percent of the total revenue — typically between \$30,000 and \$40,000 annually. At the end of the season, the containers are passed off to the next batch of entrepreneurs.

While the Square Roots model is capable of bringing fresh, sustainably grown food to city dwellers no matter the season, it's not perfect. Half of their costs are dedicated to paying electricity bills, so they're still looking for more efficient ways to power the farms. And with 10 farms producing a combined 500 pounds of food

per week, they're a long way from feeding all 8.5 million residents of New York City.

## Farming Fish (and Basil) in Pittsburgh

Farther west, in Pennsylvania, students from the University of Pittsburgh, Carnegie Mellon University, and the University of Michigan are working together on the Aquaponics Project. Named for the combined use of hydroponics (a method of growing plants with a continuous supply of nutrient-rich water instead of soil) and aquaculture (farming fish, crustaceans and plants in water), the project aims to efficiently and sustainably provide food for local communities.

Similar to Square Roots, the Aquaponics Project uses a decommissioned shipping container to house the farm. The difference, however, is that the Aquaponics Project combines a 500-gallon fish tank for tilapia with 30 vertical grow towers, all within the tank, that can each grow up to 27 basil plants. According to Kareem Adam Rabbat, president of the project, the system “relies on the symbiotic relationship between fish and plants” — the fish waste provides nutrients for the plants, and the plants keep the water clean for the





fish. According to Anish Salvi of *The Pitt News*, the only input is food for the fish, and the output is fresh, sustainably grown food. Overall, the system uses 90 percent less water and 70 percent less energy than traditional farming.

While the project started in Pittsburgh, the students have global ambitions. They hope to use the portable system to educate communities about sustainable practices for growing food and to bring fresh, healthy food to areas of the world that lack easy access to it. “It’ll just provide food for the community, whether that be a food

desert in the United States or a place in the Sahara Desert in Africa,” Rabbat said.

The team entered their project in the 2017 Ford College Community Challenge, Ford Motor Company’s sustainability contest, and took home first place with a \$35,000 grant to further the project and a 2017 Ford Transit to help make their farm mobile. They plan to use the money to add an anaerobic digester to the system and hope to finish the upgrade in the spring of 2018. The digester will convert food waste to methane, which can be used as fuel to

heat the container, potentially enabling year-round use.

With global populations rising and more and more people moving to cities, finding ways to improve, augment or even replace the ways in which we grow and deliver food with sustainable solutions is becoming more important than ever. Both Square Roots and the Aquaponics Project are just getting started, but they provide an interesting glimpse into the possible future of farming.







# Making a Difference in the World — Together

Join us in our efforts to be more sustainable and reduce our carbon footprint. The Fisher Scientific Sustainability Program strives to help customers and suppliers protect and preserve the environment by supporting and encouraging the achievement of sustainability goals through our practices, products and programs.

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

## Practices

Our best practices include:

- Six LEED-certified buildings
- 13 Zero Waste facilities

## Products

We offer thousands of green products that meet FTC guidelines and are compliant with other state and federal laws.

## Programs

We partner with suppliers to reduce, reuse, and recycle by consolidating orders, offering electronic invoices, providing electronic literature, and more.

Visit [fishersci.com/sustainabilityreport](https://fishersci.com/sustainabilityreport) to download a copy of the Thermo Fisher Scientific Corporate Social Responsibility Report and see all the ways we are committed to a healthier, cleaner, and safer world.





# New and Improved

## Fisherbrand HandyStep S Pipette and Tips

The new Fisherbrand HandyStep S Repeating Pipette is comfortable, dependable, and simple to operate. When used with Fisherbrand dispenser tips, users can achieve 59 different volume settings with accuracy and precision.

- Lightweight and well balanced for smooth dispensing and one-handed volume selection
- Mechanical design uses corrosion-resistant polymers for a dependable instrument that lasts
- Tip ejection system allows you to remove tips without handling

Fisherbrand Dispenser Tips are manufactured from high-quality virgin plastics for use with all standard repeating pipettes.

- Precision seal ensures smooth operation and increased accuracy and precision
- Made without chemical additives to prevent reagent contamination



Description	Cat. No.	Price
Fisherbrand	<b>R91540004C</b>	\$96.33

### Fisherbrand Dispenser Tips

Capacity	Quantity	Cat. No. Nonsterile	Price	Cat. No. Sterile	Price
0.1mL	100/Pack	<b>13-668-700</b>	\$156.00	<b>13-668-710</b>	\$203.00
0.5mL	100/Pack	<b>13-668-701</b>	\$166.00	<b>13-668-711</b>	\$203.00
1mL	100/Pack	<b>13-668-702</b>	\$161.00	<b>13-668-712</b>	\$196.00
1.25mL	100/Pack	<b>13-668-703</b>	\$166.00	<b>13-668-713</b>	\$200.00
2.5mL	100/Pack	<b>13-668-704</b>	\$167.00	<b>13-668-714</b>	\$195.00
5mL	100/Pack	<b>13-668-705</b>	\$166.00	<b>13-668-715</b>	\$201.00
10mL	100/Pack	<b>13-668-706</b>	\$161.00	<b>13-668-716</b>	\$190.00
12.5mL	100/Pack	<b>13-668-707</b>	\$161.00	<b>13-668-717</b>	\$196.00
25mL*	50/Pack	<b>13-668-708</b>	\$90.00	N/A	N/A
25mL*	25/Pack	N/A	N/A	<b>13-668-718</b>	\$58.00
50mL*	25/Pack	<b>13-668-709</b>	\$51.00	<b>13-668-719</b>	\$49.00
Adapters for 25 & 50mL Tips	5/Pack	N/A	N/A	<b>13-668-721</b>	\$70.00
	10/Pack	<b>13-668-720</b>	\$100.00	N/A	N/A

\* Includes one adapter.

# Durable and Reusable

## Fisherbrand Laboratory Glassware

### Fisherbrand Reusable Glass Low-Form Griffin Beakers

- 33 expansion borosilicate glass
- Thick, heavy construction with beaded top; uniform wall thickness
- Durable, matte-finish marking area
- Easy-to-read, white, graduated double scale
- Highly resistant to chemicals and thermal shock
- USP; compliant with ASTM E468, E 960 Type I



### Fisherbrand Griffin Beakers

Capacity	Cat. No.	Quantity	Price
50mL	<b>FB10050</b>	12/Pack	\$58.83
		48/Case	\$186.25
100mL	<b>FB100100</b>	12/Pack	\$61.86
		48/Case	\$196.73
150mL	<b>FB100150</b>	12/Pack	\$59.19
		48/Case	\$188.37
250mL	<b>FB100250</b>	12/Pack	\$59.29
		48/Case	\$188.45
400mL	<b>FB100400</b>	12/Pack	\$69.66
		48/Case	\$221.40
600mL	<b>FB100600</b>	6/Pack	\$45.25
		48/Case	\$211.82
1000mL	<b>FB1001000</b>	6/Pack	\$83.37
		48/Case	\$265.37

### Fisherbrand Reusable Glass Media Bottles with Caps

- 33 expansion borosilicate glass
- Convenient wide openings, enhanced graduations and a replaceable, drip-free polypropylene pour ring
- Permanent white enamel marking spot
- GL 45 screw thread; linerless polypropylene caps
- Autoclavable (to 140°C)



### Fisherbrand Erlenmeyer Flasks

Description	Cat. No.	Quantity	Price
100mL	<b>FB800100</b>	10/Case	\$89.60
250mL	<b>FB800250</b>	10/Case	\$99.60
500mL	<b>FB800500</b>	10/Case	\$112.05
1000mL	<b>FB8001000</b>	10/Case	\$147.77
2000mL	<b>FB8002000</b>	1/Case	\$38.17
5000mL	<b>FB8005000</b>	1/Case	\$126.18
10000mL	<b>FB80010000</b>	1/Case	\$219.51



### Fisherbrand Reusable Glass Narrow-Mouth Erlenmeyer Flasks

- 33 expansion borosilicate glass
- Thick-walled body; reinforced top tooled with a rounded finish
- White ceramic enamel marking spot
- Long, tapered outside contour to minimize chipping
- ASTM E1404 Type I

### Fisherbrand Erlenmeyer Flasks

Description	Cat. No.	Quantity	Price
25mL	<b>FB50025</b>	12/Pack	\$75.19
		48/Case	\$233.54
50mL	<b>FB50050</b>	12/Pack	\$75.19
		48/Case	\$233.55
125mL	<b>FB500125</b>	12/Pack	\$71.95
		48/Case	\$233.30
250mL	<b>FB500250</b>	12/Pack	\$74.53
		48/Case	\$231.31
500mL	<b>FB500500</b>	6/Pack	\$47.65
		36/Case	\$218.83
1000mL	<b>FB5001000</b>	6/Pack	\$76.26
		24/Case	\$236.98
2000mL	<b>FB5002000</b>	4/Pack	\$118.34
		8/Case	\$183.66
4000mL	<b>FB5004000</b>	1/Case	\$93.99
6000mL	<b>FB5006000</b>	1/Case	\$172.72



# Safely Dispose of Glass and Broken Glass

## Fisherbrand Glass-Disposal Boxes

Dispose of glass and broken glass safely and separately from other waste.

- Made from sturdy, corrugated cardboard
- Includes tough polyethylene liner (2mm thickness)
- Clearly marked with instructions
- Unique folded lid for secure closure



Model	Dimensions (L x W x H)	Cat. No.	Quantity	Price
Benchtop	8 x 8 x 10 in. (20 x 20 x 25cm)	<b>12-009-7B</b>	6/Pack	\$85.00
Intermediate	12 x 12 x 20 in. (30 x 30 x 51cm)	<b>17-988-448</b>	6/Pack	\$130.00
Floor	12 x 12 x 27 in. (30 x 30 x 69cm)	<b>12-009-7A</b>	6/Pack	\$135.00

# Baths for Cleaning, Mixing and De-Gassing

## Fisherbrand Ultrasonic Cleaners

- Maximum versatility — choose frequency, power level, time, temperature and ultrasonic mode
- Products in stock and ready to ship
- Six tank sizes: 0.7 to 7.3 gallons
- Accessories sold separately
- Compatible with most cleaning solutions

Model	Capacity	Cat. No.	Price
FB-11201	0.7 gal.	<b>FB11201</b>	\$1,095.00
FB-11203	1.5 gal.	<b>FB11203</b>	\$1,570.00
FB-11205	1.8 gal.	<b>FB11205</b>	\$1,632.00
FB-11207	3.3 gal.	<b>FB11207</b>	\$2,681.00
FB-11209	4.75 gal.	<b>FB11209</b>	\$2,930.00
FB-112011	7.3 gal.	<b>FB11211</b>	\$3,308.00



# Protect Contents from UV Exposure

## Fisherbrand Amber Glass Bottles

Fisherbrand Amber Glass Bottles are available as Boston round bottles with black phenolic PolyCone caps or as wide-mouth packer bottles with polypropylene caps. Both styles offer protection for UV-sensitive contents. The glass offers minimal chemical interference with contents and the amber coloring absorbs all wavelengths in the ultraviolet spectrum.

- Fisherbrand Amber Boston Round Glass Bottles
  - Narrow, screw-neck openings and curved shoulders
  - Black phenolic PolyCone-lined caps form an exceptionally tight seal; as the cap closes, the liner molds itself to the opening to reduce leakage, evaporation, contamination, binding and backing off
  - Use for storing liquids, soaps, or macro-invertebrates
- Fisherbrand Amber Wide-Mouth Glass Packer Bottles
  - Wide openings make them good general-purpose containers for solids
  - Classic vitamin-style bottles are used in pharmaceutical, chemical, and environmental settings
  - Attached polypropylene (PP) caps with F217\* and polytetrafluoroethylene (PTFE) liners (an economical alternative to thermoset and phenolic PTFE-lined caps)

\*F217 liners consist of three layers: a low-density foam core tightly sandwiched between two layers of low-density polyethylene (LDPE).



### Fisherbrand Amber Boston Round Glass Bottles

Capacity	Neck Finish	Cat. No.	Quantity	Price
15mL	18-400	02-911-861	720/Case	\$1417.92
30mL	20-400	02-912-339	48/Case	\$118.68
60mL	20-400	02-911-734	24/Case	\$82.96
		02-911-898	288/Case	\$462.90
120mL	22-400	02-911-735	24/Case	\$91.33
		02-911-895	160/Case	\$197.95
240mL	24-400	02-911-900	108/Case	\$245.13
480mL	28-400	02-911-743	12/Case	\$76.42
		02-911-878	60/Case	\$289.54
960mL	33-400	02-911-744	12/Case	\$105.00
		02-911-744	12/Case	\$132.31

### Fisherbrand Amber Wide Mouth Packer Glass Bottles

Capacity	Neck Finish	Cat. No.	Quantity	Price
30mL	28-400	02-911-438	24/Case	\$103.48
60mL	33-400	02-911-439	24/Case	\$115.11
120mL	38-400	02-911-440	24/Case	\$138.50
250mL	45-400	02-911-441	24/Case	\$181.84
500mL	53-400	02-911-442	12/Case	\$119.74
950mL	53-400	02-911-443	12/Case	\$153.05



# Coated for Protection, Accessorized for Functionality

fisherbrand

## 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 to 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 60Hzww	Ultimate Vacuum	Dimensions (L x W x H)	Shipping Weight	Cat. No.	Price
M4C	2.7 CFM (78L/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>01-184-202</b>	\$3,200.00
M6C	4.2 CFM (118L/min.)			63 lb. (29kg)	<b>01-184-203</b>	\$3,525.00
M8C	5.6 CFM (158L/min.)			65 lb. (30kg)	<b>01-184-204</b>	\$3,700.00
M16C	5.6 CFM (158L/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)	200 lb. (91kg)	<b>01-184-205</b>	\$4,200.00
M24C	18.3 CFM (519L/min.)			103 lb. (47kg)	<b>01-184-206</b>	\$4,600.00
M30C	22.1 CFM (627L/min.)			106 lb. (48kg)	<b>01-184-207</b>	\$5,700.00

Exhaust Filter, Funnel, and Hose Clamp are included in all Fisherbrand Maxima pump packages.

## Process Samples in Seconds

### Fisherbrand Bead Mill 4 and 24 Homogenizers

- Convenient front-loading tube holder
- No cooldown required between runs
- Rapid processing reduces sample degradation
- Smaller footprint maximizes bench space

#### Bead Mill 4 Homogenizer

- Simultaneously process 0.5mL, 1.5mL, 2mL and 7mL samples (tube carriages included)
- Gentle mixing to high-force homogenization

#### Bead Mill 24 Homogenizer

- Processing range is ideal for soft tissue samples
- Simultaneously homogenize up to 24 x 0.5mL or 2mL tubes



Description	Cat. No.	Price
Fisherbrand Bead Mill 4 Homogenizer	15-340-164	\$2,075.00
Fisherbrand Bead Mill 24 Homogenizer	15-340-163	\$7,200.00

## Designed for Comfort and Durability

### Fisherbrand Guest Chairs

#### Hillendale Upholstered Guest Chairs

- Highly durable sled base
- Foam cushioning covered with durable black nylon mesh fabric
- Fixed armrests provide style and comfort
- Five-year warranty

#### Oxford Modern Guest Chairs

- Black, powder-coated steel tubular sled base with scuff-resistant glides
- Foam cushioning covered with durable black nylon mesh fabric
- Five-year warranty

#### Windrowe Executive Guest Chairs

- Highly durable sled base
- Foam cushioning covered with durable black nylon mesh fabric
- Five-year warranty



Description	Style	Cat. No.	Price
Hillendale Upholstered Guest Chairs, Black	Fixed Arm Rests, Upholstered Pads	14-359-523	\$153.00
Oxford Modern Guest Chairs, Black	With Adjustable Arms	14-359-524	\$208.00
	Without Arms	14-359-525	\$188.00
Windrowe Executive Guest Chairs, Black	With Arms	14-359-526	\$240.00
	Without Arms	14-359-527	\$223.00



# TURNING TRASH INTO TECHNOLOGY

By Kevin Ritchart

As electronic waste in Africa continues to mount, one company has pioneered a method of creating 3D printers out of discarded phones, computers and other electronic devices.

The first African-made 3D printer was produced from e-waste in 2013 at WoeLab, a maker space located near the university in Lomé, the capital city of Togo in West Africa.

Large volumes of e-waste — 42 megatons per year — arrive from wealthier Western countries to places in Africa, India and China. Items like batteries, refrigerators and other equipment produce deadly carcinogenic toxins when burned, and less than one sixth of it is recycled or reused every year.

## The Idea

Rather than burn the electronics and release hazardous materials into the atmosphere, WoeLab architect Sénamé Koffi Agbodjinou came up with the idea to construct a 3D printer using little more than scrap printers, computers and scanners.

Agbodjinou had purchased a 3D printer for WoeLab, and then he and his colleagues decided to take a run at building one on their own from salvaged parts. After a year of effort, Agbodjinou and his team were successful.

“We wanted to see how we could build a new one but with our own resources,” Agbodjinou said.

Now almost five years later, WoeLab has produced twenty 3D printers and other companies in Africa are following suit.

## Going High-Tech

Agbodjinou founded WoeLab in 2012 as a maker space to promote urban renewal, local sourcing and sustainable technology.

WoeLab and other similar organizations are pushing to make Africa a much more tech-centered continent, and that effort starts with innovation.

“The idea is that the African city of tomorrow will be built by our own innovation spaces,” Agbodjinou said.

To help foster technological learning in their nation’s youth, WoeLab is planning to place a 3D printer in every school within one kilometer of its facility.

“What we are concerned with is to try to create in the young people a confidence in themselves in their capacity to realize projects,” Agbodjinou said.

## An Eye on the Future

The printers created by WoeLab can print objects up to 50 cubic centimeters in size. WoeLab now has a staff of 50 people working in two facilities, and there are 10 startup companies aimed at furthering tech-based projects, from the construction of robots and prosthetic limbs to waste reduction.

“We want to bring these technologies to Africa, and see how Africans can develop and understand them in an effort to create African possibilities,” Agbodjinou said.





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Labs today are looking for equipment that not only works well but that also helps them to fulfill their missions for improved sustainability and productivity. In response to that need, Thermo Scientific TSX Series Ultra-Low Temperature (ULT) Freezers have been designed to provide a unique combination of energy savings, fast door-opening temperature recovery and low peak-temperature variation. And, like all Thermo Scientific equipment, these models have been designed to maximize lab efficiencies while fostering sustainability.

## Energy Efficiency

Energy efficiency can have a significant impact on the operation and environmental impact of laboratories. All TSX Series and other Thermo Scientific ULT freezers, a total of 42 in all, have been ENERGY STAR certified since July 2017. The United States Environmental Protection Agency ENERGY STAR program for reduced energy usage requires that units operate within the program's 0.55 kW-hr/day per cubic foot threshold to receive this certification.

## Sample Protection

Products in the TSX Series are equipped with industry-leading capabilities aimed at preserving the integrity and viability of your precious samples. Whether you access your freezer multiple times daily or have sensitive biological samples that require tight thermal controls, the TSX Series offers you peace of mind that your important results won't be compromised.

With their unique V-drive technology, TSX Freezers can rapidly recover to -75°C within just 17 minutes after the door has

been opened.\* The TSX Series of ULT freezers also exhibits the lowest peak variation on the market; temperature stability and uniformity is maintained throughout the chamber, effectively protecting all stored samples regardless of their position within the cabinet.

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Visit [fishersci.com](https://fishersci.com) to find the right Thermo Scientific TSX Series ULT Freezer for your lab.

Content provided by:

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Represents the \*TSX400 model; typical performance varies by size and voltage of freezer.

Prices are U.S. list prices — pricing in Canada may vary





# Reliable Temperature Management

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### Ultra-Low Temperature Freezers (-80°C)

- Temperature varies less than 5°C, the best of any energy-efficient ultra-low temperature freezer
- Recovers in just 17 minutes after door opening, which is the fastest on the market
- Uses less than 8kWh/day, depending on freezer size

### High-Performance Lab Refrigerators and Freezers (-20°C)

- Significant energy savings with alternate compressor technology
- Standard door locks, ergonomic door handle, and slanted control panel
- Low noise: 50dBA for manual defrost freezers, 52dBA for auto-defrost models



### TSX Series Ultra-Low Temperature (-86°C) Freezers

Description	Capacity	Electrical Requirements	Cat. No.	Price
Model TSX400 Freezer	400 Boxes	110V/60Hz	TSX40086A	\$20,855.00
		220V/60Hz	TSX40086D	\$20,855.00
Model TSX500 Freezer	500 Boxes	110V/60Hz	TSX50086A	\$22,458.00
		220V/60Hz	TSX50086D	\$22,458.00
Model TSX600 Freezer	600 Boxes	110V/60Hz	TSX60086A	\$24,061.00
		220V/60Hz	TSX60086D	\$24,061.00
Model TSX700 Freezer	700 Boxes	110V/60Hz	TSX70086A	\$26,641.00
		220V/60Hz	TSX70086D	\$26,641.00

### TSX Series High-Performance Refrigerators and Freezers (-20°C)

Description	Capacity	Electrical Requirements	Cat. No.	Price
TSX Refrigerator (+5°C), Glass Door, Auto-Defrost	23 cu. ft.	110V/60Hz	TSX2305GA	\$7,935.00
		220V/60Hz	TSX2305GD	\$7,708.00
TSX Refrigerator (+5°C), Solid Door, Auto-Defrost	23 cu. ft.	110V/60Hz	TSX2305SA	\$7,281.00
		220V/60Hz	TSX2305SD	\$7,070.00
TSX Freezer (-20°C), Solid Door, Manual Defrost	23 cu. ft.	110V/60Hz	TSX2320FA	\$8,935.00
		220V/60Hz	TSX2320FD	\$8,935.00

# Ductless Chemical Workstations Laminar Flow Workstations

**AirClean® Systems**

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## 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 particulate. Ships fully assembled and can be configured for a variety of common applications.

### Standard Features:

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

Description	Catalog No.	Price
AC632A 32" Workstation	36-100-4271	\$3,635.00
AC632TA 32" Workstation, Tall Version	36-100-4272	\$4,077.00
AC648A 48" Workstation	36-100-4274	\$5,112.00
AC648TA 48" Workstation, Tall Version	36-100-4275	\$5,177.00

Filters sold separately; application worksheet required.

## Combination PCR Workstation

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. 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 0-59 minutes
- UV shelf with integral pipette holder

PCR Workstation	Catalog No.	Price
AC632LFUVC 32" PCR Workstation	36-101-8894	\$3,396.63
AC648LFUVC 48" PCR Workstation	36-101-8897	\$4,528.84



## Endeavour Ductless Fume Hood

The Endeavour Ductless Fume Hood is designed to provide superior operator protection from potential toxic fumes, vapors, and particulate. 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	Catalog No.	Price
ACPT4000 48" Ductless Fume Hood	36-100-0063	\$7,500.00
ACPT5000 60" Ductless Fume Hood	36-100-0067	\$9,159.47
ACPT6000 72" Ductless Fume Hood	36-100-0069	\$8,850.00

Filters sold separately; application worksheet required.





# Filtered Laboratory Safety Solutions



Mystaire manufactures fume hoods and laminar flow hoods to provide operator and 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

Description	Mfr. No.	Cat. No.	Price
Latitude, W: 48"	MY-LBE48	15-338-965	\$7,500.00
Latitude, W: 72"	MY-LBE72	15-338-966	\$9,500.00



## 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 offers 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

Description	Mfr. No.	Cat. No.	Price
Isola, W: 36"	MY-ISL36	15-338-900	\$4,552.50
Isola, W: 48"	MY-ISL48	15-338-901	\$5,628.00
Isola, W: 72"	MY-ISL72	15-338-902	\$7,236.00

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

Description	Mfr. No.	Cat. No.	Price
MY-PCR, W: 24"	MY-PCR24	15-338-365	\$2,554.29
MY-PCR, W: 32"	MY-PCR32	15-338-366	\$3,202.93
MY-PCR, W: 48"	MY-PCR48	15-338-367	\$3,850.00

MY-PCR Filters included in the purchase price.

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Model	Capacity	Readability	Cat. No.	Price
<b>Analytical Balances</b>				
AX124	120g	0.0001g	01-920-251	\$3,267.16
AX224	220g	0.0001g	01-920-253	\$3,532.07
AX324	320g	0.0001g	01-920-254	\$4,085.91
AX223	220g	0.001g	01-920-275	\$3,932.58
<b>Precision Balances</b>				
AX523	520g	0.001g	01-920-279	\$2,499.98
AX622	620g	0.01g	01-920-266	\$1,493.21
AX2202	2200g	0.01g	01-920-270	\$2,098.94
AX5202	5200g	0.01g	01-920-273	\$2,909.94
AX4201	4200g	0.1g	01-920-257	\$1,630.03
AX8201	8200g	0.1g	01-920-259	\$1,762.15

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## Plas Labs Chambers and Glove Boxes

### Anaerobic Chamber, Model 855

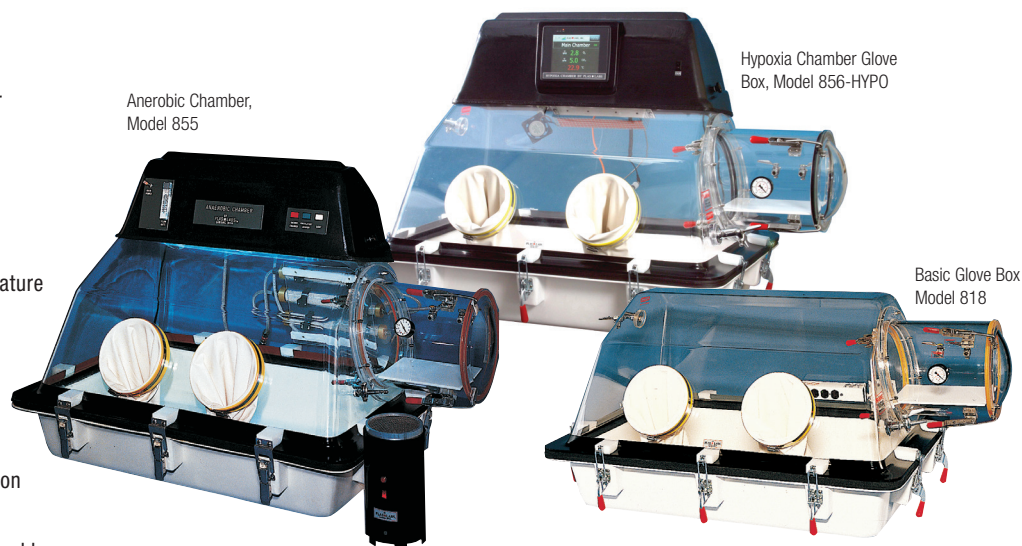
- Includes glove ports, gloves, a transfer tray, hospital-grade outlet strip, and catalyst heater
- Factory-set temperature of 37°C (98.6°F)
- Two-year warranty

### Hypoxia Chamber Glove Box, Model 856-HYPO

- Controls specific levels of CO<sub>2</sub>, O<sub>2</sub>, and temperature
- Ideal for stem cell and cancer cell research
- Two Year warranty

### Basic Glove Box, Model 818

- Provides a simple enclosure for general isolation or containment work
- Compact, portable, lightweight and easily moveable



Description	Dimensions (W x H x D)	Certifications	Voltage	Cat. No.	Price
Anaerobic Chamber, Model 855	55 x 38 x 35 in. (140 x 97 x 89cm)	UL Listed, CSA Certified, CE Marked	120V	11-391-106	\$20,530.00
Hypoxia Chamber Glove Box, Model 856-HYPO	55 x 38 x 35 in. (140 x 97 x 89cm)	UL Listed	220V	11-389-132	\$25,400.00
Basic Glove Box, Model 818	55 x 38 x 35 in. (140 x 97 x 89cm)	UL Listed, CSA Certified (CA)	120V	11-389	\$10,500.00





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- 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.	Price
<b>Chemical-Resistant Vacuum Pumps: For Evaporation, Vacuum Ovens, Vacuum Concentration</b>					
UN820.3FTP	2 Stage	20L/min.	6 torr (8 mbar)	<b>13-878-27</b>	\$2,958.00
UN840FTP	Single Stage	34L/min.	75 torr (99 mbar)	<b>13-878-44</b>	\$2,869.00
UN840.3FTP	2 Stage	34L/min.	6 torr (8 mbar)	<b>13-878-29</b>	\$3,978.00
UN842.3FTP	2 Stage	34L/min.	1.5 torr (2 mbar)	<b>13-878-35</b>	\$5,969.00
<b>Mini Filtration Vacuum Pumps: For Vacuum Desiccation, Degassing, Solvent Filtration</b>					
UN86KTP		5.5L/min.	120 torr (160 mbar)	<b>13-878-38</b>	\$772.00
UN811 KVP		13L/min.	75 torr (100 mbar)	<b>13-880-34</b>	\$887.00
UN816.3KTP		16L/min.	15 torr (20 mbar)	<b>13-880-30</b>	\$1,356.00
UN816.1.2KTP		30L/min.	120 torr (160 mbar)	<b>13-880-32</b>	\$1,390.00

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Condenser Type	Capacity	Lift Type	Vacuum Pump	Controller	Cat. No.	Price
Cold Trap	5L	Electronic	N/A	N/A	<b>05-000-947</b>	\$7,135.00
Vertical	5L	Electronic	N/A	N/A	<b>05-000-977</b>	\$6,725.00
Cold Trap	5L	Electronic	N/A	I-300	<b>05-000-949</b>	\$9,792.00
Vertical	5L	Electronic	N/A	I-300	<b>05-000-979</b>	\$9,383.00
Cold Trap	5L	Electronic	V-300	I-300	<b>05-001-070</b>	\$13,638.57
Vertical	5L	Electronic	V-300	I-300	<b>05-001-076</b>	\$12,742.82
Cold Trap	5L	Manual	N/A	N/A	<b>05-000-455</b>	\$5,847.00
Cold Trap	5L	Manual	N/A	N/A	<b>05-000-461</b>	\$6,041.00
Vertical	5L	Manual	N/A	N/A	<b>05-000-485</b>	\$5,433.00

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- A quick chuck for easy impeller changes
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Model	Capacity	Gear and Speed	Mfr. No.	Cat. No.	Price
Value 100	50L	1: 10 to 2000rpm	036093030	<b>13-880-450</b>	\$2,116.00
Value 200	50L	1: 10 to 2000rpm	036093050	<b>13-880-451</b>	\$3,004.00
Value 400	100L	1: 40 to 400rpm; 2: 200 to 2000rpm	036093070	<b>13-880-452</b>	\$3,824.00
Precision 100 - USB & RS 232	50L	1: 10 to 2000rpm	036093090	<b>13-880-453</b>	\$2,521.00
Precision 200 - USB & RS 232	50L	1: 10 to 2000rpm	036093110	<b>13-880-454</b>	\$3,358.00
Precision 400 - USB & RS 232	100L	1: 40 to 400rpm; 2: 200 to 2000rpm	036093150	<b>13-880-455</b>	\$4,600.00

# GENETIC MODIFICATION: SURVIVAL OF THE FITTEST

By Ralph Birch

A synthetic biologist, biochemist and their colleagues at the University of Minnesota in Minneapolis-St. Paul have used gene-editing tools to create genetically modified yeast that cannot breed successfully with its wild counterparts. In so doing, they claim to have engineered a synthetic species.

“We want something that’s going to be identical to the original in every way, except it’s just genetically incompatible,” said Maciej Maselko, who presented his team’s work earlier this year at the annual Plant and Animal Genome Conference in San Diego, California.

## Practical Uses

The researchers, co-led by biochemist Michael Smanski, hope the technology can be used to keep genetically modified plants from spreading genes to unmodified crops. It may even help combat pests and invasive species by replacing wild organisms with modified counterparts.

Although the approach is promising, success could be hampered by technical hurdles, like the ability of modified organisms to successfully survive in the wild. “This is an ingenious system and, if successful, could have many applications,” said Fred Gould an evolutionary biologist from North Carolina State University.

Maselko and Smanski used the CRISPR–Cas9 gene-editing tool to alter gene expression rather than edit the targeted genes. The Cas9 enzyme was used to over-activate protein production in the cells to toxic levels. The technique was successful — initial experiments with brewer’s yeast (*Saccharomyces cerevisiae*) increased actin levels so much that the cells actually exploded.

## The Mating Ritual

The team introduced two modifications to prevent genetically modified yeast from mating successfully with unmodified strains. The first was analogous to a “poison” and produced a version of Cas9 that recognized and over activated the actin gene. The second modification or “antidote” kept Cas9 from overexpressing actin.

A yeast strain that contained both the poison and the antidote produced healthy offspring when mated with yeast that had the antidote only. But when the modified strain was crossed with a different strain that lacked the antidote, the majority of the offspring popped like over-inflated balloons, the Minnesota team reported in *Nature Communications* in October 2017.

A synthetic species could also be used to control undesirable species that spread disease or harm ecosystems. Siba Das, also from the University of Minnesota, presented a mathematical model at the same conference that showed how synthetic speciation could potentially combat the proliferation of Asian carp, an invasive species that has been overtaking rivers and lakes in the U.S.

## The Drawback

Genetic modifications to stop interbreeding also could carry a steep evolutionary cost, according to Omar Akbari, a molecular biologist at the University of California, San Diego. The Cas9 enzyme doesn’t always recognize its intended gene and might accelerate the activity of other genes.

Such actions could be detrimental to the health of modified organisms, but further experimentation is needed. “I’m not sure if this is going to generate a fit-enough strain to compete in the wild,” Akbari said.



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- Washing, media replacement and reagent injection



Model	Description	Cat. No.	Price
BioSpa 8	Incubation to 45°C with Control and Monitoring	<b>11120550</b>	\$40,930.00
Cytation 5	Fluorescence, High-Contrast Brightfield and Color Brightfield Imaging, Includes Gen5 Software	<b>BTCYT5V</b>	\$55,525.00

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Model	Description	Cat. No.	Price
800 TS	For 6- to 96-Well Plates, 400 to 750nm Detection	<b>BT800TS</b>	\$6,250.00
50 TS	For 96-Well Strip or Full Plates, 8-Well Manifold	<b>BT50TS8</b>	\$6,250.00

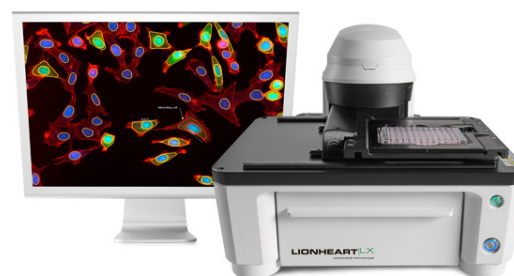
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Model	Description	Cat. No.	Price
Lionheart LX	Fluorescence, High-Contrast Brightfield and Color Brightfield Imaging, Includes Gen5 Software	<b>BTLX</b>	\$35,800.00

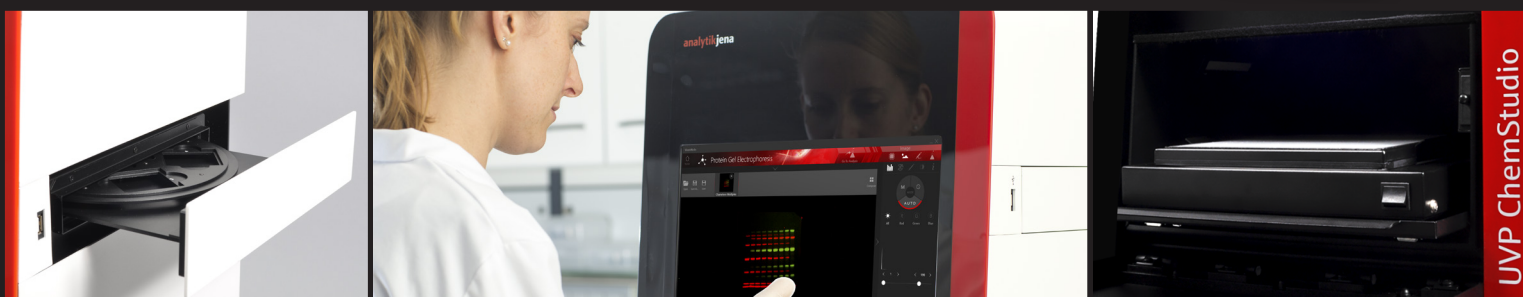
Catalog numbers shown may not reflect all product features listed. Contact your **Fisher Scientific Sales Representative** to learn more about other available configurations.

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Description	Camera & Lens	Software Control	Mfr. No.	Cat. No.	Price
UVP ChemStudio touch	8.1MP, f/0.95	Integrated touchscreen	849-97-0928-01	84-997-092801	\$30,009.76
UVP ChemStudio	8.1MP, f/0.95	PC-controlled	849-97-0928-03	84-997-092803	\$27,932.96



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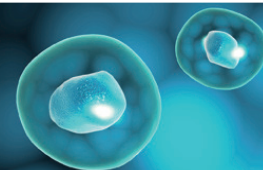
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KA2396120118AD

Membrane Material	Quantity	Cat. No.	Price	Cat. No.	Price
Pore Size		0.2µm		0.45µm	
Nylon	100/Pack	09-923-101LR	\$202.50	09-923-29LR	\$202.50
Polytetrafluoroethylene (PTFE)	100/Pack	09-923-102LR	\$202.50	09-923-28	\$406.44
Polyvinylidene fluoride (PVDF)	100/Pack	09-923-100	\$422.03	09-923-25LR	\$202.50
Polyethersulfone (PES)	100/Pack	09-927-651	\$363.69	09-923-30	\$423.08



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CE IVD

Product	Mfr. No.	Cat. No.	Quantity
CytoQuest CR (Circulating Rare Cell Positive Enrichment & Retrieval System)	M0014-04	<b>89-333-000</b>	Eash
CytoQuest Universal Circulating Tumor Cell CSV CSV CD45 Antibody Kit	KA4818	<b>89-333-010</b>	20 Assays
CytoQuest Lung Cancer CSV CSV CD45 TTF1 Antibody Kit	KA4907	<b>89-333-019</b>	20 Assays
CytoQuest Prostate Cancer CSV CSV CD45 PD-L1 Antibody Kit	KA4909	<b>89-333-021</b>	20 Assays
CytoQuest Extravillous Trophoblast HLA-G TBA Antibody Kit	KA4515	<b>89-139-343</b>	20 Assays
CytoChipNano Combo Pack	KA4927	<b>89-333-024</b>	20 Assays
mutaFISH EGFR T790M T790wt RNA Probes	FP0001	<b>89-333-032</b>	1 Set
mutaFISH EGFR L858R L858wt Ex19wt RNA Probes	FP0002	<b>89-333-033</b>	1 Set
mutaFISH AR-V7 ARwt RNA Probes	FP0004	<b>89-333-034</b>	1 Set

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TCx thermal control

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# THE COST OF CLIMATE CHANGE

By Hamilton Waldron

While the causes of natural disasters vary, and questions about the role of climate change persist, no one disputes their costs: in 2017 alone, damage from extreme weather events for the United States totaled \$306 billion.

A trifecta of hurricanes was to blame for most of that costly damage. Hurricanes Harvey, Irma and Maria became the household names that marked 2017 as an especially turbulent year for natural disasters, but other noteworthy weather events had impacts as well.

In Pennington County, South Dakota, 13 cows were found dead in a field. The cause of death? Ingesting anthrax spores from the soil. It happened in November 2017 when the herd was forced to alter its grazing routines during a nearly yearlong drought across South Dakota, North Dakota and Montana.

At the very least, these natural disasters can be tied to a warming trend, as the United States experienced its third-warmest year on record in 2017. The temperature surged to 2.6 degrees Fahrenheit above the 20th-century average, according to Jake Crouch, a climate scientist with the U.S. National Oceanic and Atmospheric Administration (NOAA).

Adam Smith, an NOAA climatologist, believes that climate change is “playing an increasing role in the increasing frequency of some types of extreme weather that lead to billion-dollar disasters, most notably the rise in vulnerability to drought, lengthening wildfire seasons and the potential for extremely heavy rainfall and inland flooding.”

Solomon Hsiang, a public policy professor at the University of California, Berkeley,

has studied how natural disasters impact societies and believes that the economic effects of the 2017 disasters may resonate for years to come.

“While we have to be careful about knee-jerk cause-effect discussions,” cautioned Marshall Shepherd, a meteorology professor at the University of Georgia, “the National Academy of Science and recent peer-reviewed literature continue to show that some of today’s extremes have climate change fingerprints on them.”

The long-lasting effects of these natural disasters will continue to be costly, and while the cause of any single event cannot be directly attributed to climate change, experts expect an even greater frequency of such extreme weather events in the future — a forecast that is no doubt alarming to not only a wide swath of Americans, but also to climatologists and economists alike.





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Trigger Spray Bottles, 16 oz. (0.47L)	9816	04-355-160	Each	\$15.17
			12/Case	\$182.11

\* Available as a sterile product (Peroxigen ST) in cases of 16 oz. trigger spray bottles. Sterile products are gamma-irradiated to SAL 10<sup>-6</sup>, tested for sterility, and shipped with lot-specific documents.

CiDehol 70 is a 70% (v/v) isopropyl alcohol (IPA) solution that meets United States Pharmacopeia (USP) specifications and is filtered to 0.2µm.

- For cleaning surfaces and hoods in microbiology labs and tissue culture labs
- An effective surface and process equipment cleaner for pharmaceutical, biotechnology, and medical device facilities
- No rinsing required — IPA solutions evaporate completely
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- Available in other convenient sizes (up to 55 gal. drums)

### CiDehol\*\*

Description	Mfr. No.	Cat. No.	Quantity	Price
Trigger Spray Bottles, 16 oz. (0.47L)	8416	04-355-63	Each	\$21.63
			12/Case	\$209.87
Trigger Spray Bottles, 32 oz. (0.94L)	8432	04-355-250	Each	\$36.05
			12/Case	\$372.65
Jugs, 1 gal. (3.8L)	8401	04-355-71	Each	\$74.16
			4/Case	\$252.92
Jugs, 5 gal. (20L)	8406	04-355-130	Each	\$288.40
Drums, 55 gal. (209L)	8405	04-355-42	Each	\$2,390.63

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# THE NEXT PHASE OF RECYCLING: GLOVES AND APPAREL

As recycling in labs and cleanrooms becomes the norm rather than the exception, facilities are becoming more proficient at recycling primary commodities such as cardboard, paper, plastic and aluminum.

But to accomplish a higher level of diversion or zero waste, nontraditional or secondary commodities must also be diverted from landfill and repurposed into usable products and durable goods.

Glove and apparel recycling is a relatively new form of recycling that is gaining traction in lab and cleanroom settings. In 2011, Kimberly-Clark Professional launched the RightCycle Program, the first large-scale recycling effort for non-hazardous lab, cleanroom and industrial waste. Since then, the program continues to help over 300 facilities divert more than 450 tons of waste from landfills.

As long as gloves, garments and accessories are not considered biohazardous, they can be recycled and turned into items such as:

- Totes
- Shelving
- Lawn and garden furniture

## It All Adds Up

Lab and cleanroom workers can use several pairs of gloves in a day. While this is necessary, the amount of waste generated really adds up.

Consider these statistics:

- One university estimated that nearly 30 percent of its waste stream came from laboratory and research buildings
- A University of Washington lab waste audit found that 22 percent of its research waste consisted of nitrile gloves
- A University of California Santa Cruz (UCSC) laboratory waste assessment found that nitrile gloves made up a majority of laboratory waste destined for landfills

Because of this, many labs are participating in the RightCycle Program, shipping used gloves and apparel to domestic recycling facilities where they are turned into plastic pellets and then reprocessed into durable consumer goods.

## Putting Glove Recycling into Practice

The University of Washington and UCSC now participate in the RightCycle Program, as do the Illinois Sustainable Technology Center (ISTC) at the University of Illinois, and Purdue University.

University laboratories aren't the only facilities that have adopted this innovative recycling solution. MilliporeSigma has diverted nearly 15 tons of waste since joining the program in 2014.

The environmental benefits of glove and apparel recycling programs are evident. They take commonly used and essential lab and cleanroom products out of the solid waste stream, significantly reducing waste generation.

As Kevin O'Brien, PhD, director of ISTC, puts it,

"If you ever used gloves as part of your laboratory work, you quickly appreciate the value this program brings from a sustainability perspective."

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