



DEMOCRATIZING MOLECULAR BIOLOGY

Enabling Next-Gen Molecular Techniques &
Rapid Nucleic Acid Extractions



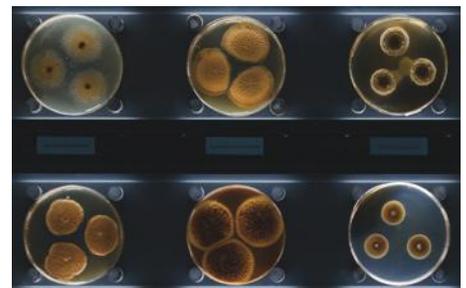
In the Beginning ...

Microfluidics Genes Enzymes Microbials

Our name says it all. Micro refers to our expertise in microfluidics and GEM stands for Genes, Enzymes, and Microbes.

Our founding mission was to discover new organisms and enzymes in extreme environments that could be used for industrial applications. The beautiful geysers, hot pools, and volcanoes of New Zealand and Antarctica provided a wealth of extremophilic bacteria that have the unusual ability to grow and thrive at temperatures between 0° C and 100° C. The enzymes produced from these bacteria are ideally suited for multiple reactions because they function and are stable at such high temperatures.

Our search for the perfect proteinase led us to a bacterium found high on the slopes of Mount Erebus, a highly active volcano in Antarctica. We named it EA1 Proteinase - Erebus Antarctica Isolate 1, a powerful enzyme that lyses cells, digests proteins, and extracts DNA/RNA directly without the typical purification steps. The elegance of this solution is that you get final results using a single tube without using harsh detergents, tedious bindings, washes, or elutions.



MicroGEM's proprietary culture collection of more than 2,000 extremophiles ranges from psychrophilic fungi to hyperthermophilic archaea.

Our mission is to advance molecular biology by reducing complexity and enabling portability outside the laboratory.

Today, our scientists at MicroGEM are moving molecular biology from the hands of a few to the hands of many. We've taken our first step not only to advance molecular biology in the laboratory but also to enable portability to the field. This is especially important for emergent nations around the world without access to laboratory equipment and services. We've reduced the complexity, stabilized the chemistry, and automated the sample preparation process, so that scientists are able to get results in 20 minutes or less. Our mission is to advance scientific discoveries by democratizing molecular biology.



“At MicroGEM™ we have discovered how to simplify life science research by reinventing the way nucleic acids are extracted. Using novel chemistries, we've enabled samples to be Molecular Biology-ready in one easy step using single-tube DNA/RNA extraction.”

– **Dr. David Saul**

Chief Scientific Officer
MicroGEM - New Zealand

An Enzymatic Approach to Nucleic Acid Extraction

Quick turnaround time is essential for successful downstream processing of nucleic acids.

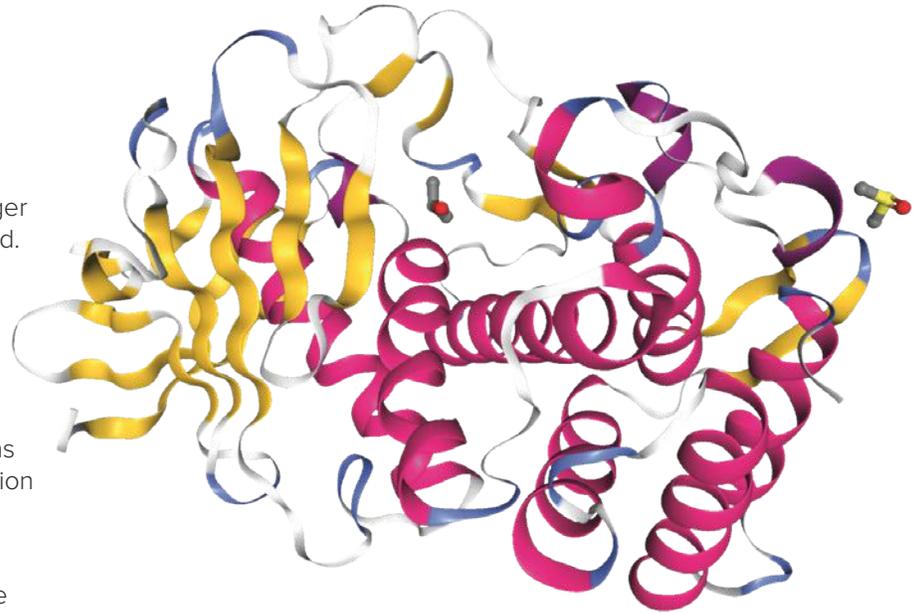
We take an enzymatic approach to nucleic acid extraction and ensure the integrity of the nucleic acid sample without the need to add inhibitory agents like SDS. Our EA1 proteinase, a thermophilic enzyme that works optimally at 75°C, works in mild buffers so the protein's molecular structure can be modified without using harsh chemicals – all done at temperatures where proteins naturally denature in minutes, not hours.

How is such quick turn-around time possible?

- There is no need to add an ionic detergent to the process.
- The laborious purification steps are no longer needed because nothing inhibitory is added.
- It is now possible to go from sample to downstream application in 20 minutes or less in a single tube simply using heat to switch enzymes on and off.

Removing steps saves time, decreases cost, diminishes potential contamination, and lessens environmental impact with a substantial reduction in waste.

But more importantly, it reduces the loss of DNA/RNA while massively lowering the chance of error, making our chemistry ideal for rapid, high-quality extractions, including from low cell-number samples.

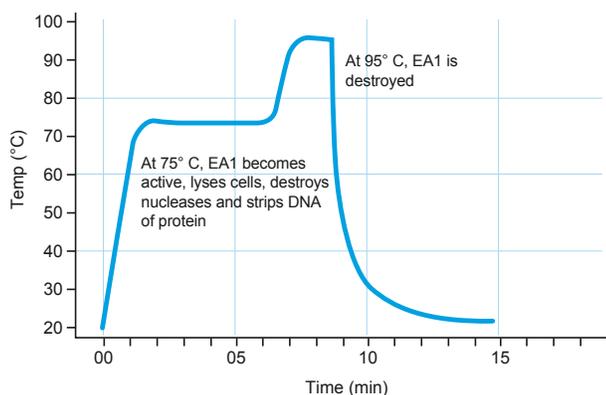


EA1 Proteinase - Erebus Antarctica Isolate 1 structure model.

Temperature-Driven Extractions

Single Enzyme Temperature-Driven Extraction

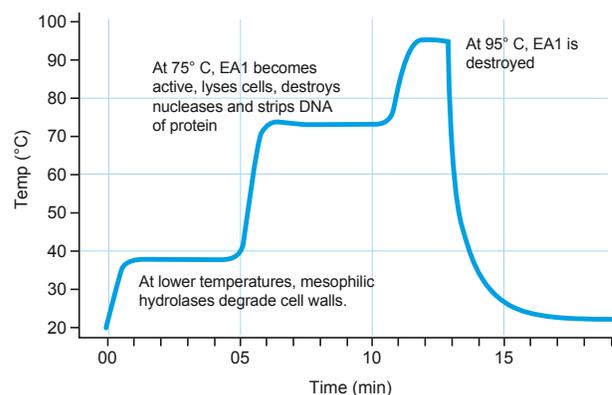
Suitable for nucleic acid extraction from cells, blood, saliva, etc.



Single Enzyme Extractions – Our prepGEM technology uses a simple temperature change to activate the thermophilic enzyme to produce single-stranded DNA, free of proteins.

Multi-Enzyme Temperature-Driven Extraction

Suitable for nucleic acid extraction from bacteria, fungi, sperm, plant, etc.



Multi-Enzyme Extractions – The low activity of our prepGEM proteinase at mesophilic temperatures means cell wall-degrading enzymes can be used in concert for many sample types.

The Secret Behind the Science

Leveraging our unique chemistries and temperature control throughout the entire extraction process

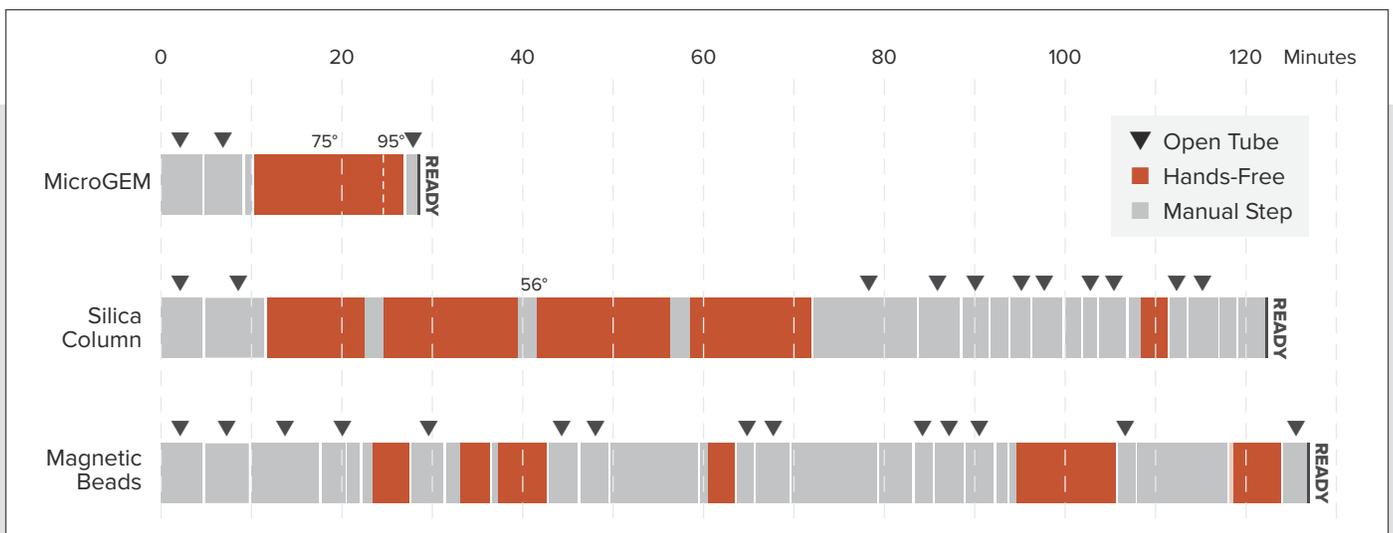
Making the EA1 discovery was just the beginning. Finding the EA1 thermophilic proteinase led us to develop proprietary extraction kits for the life sciences, biopharmaceutical, agriculture biotechnology, medical research, and forensic markets. Using cocktails of enzymes at different temperatures, a sequence of coordinated reactions can be performed by simply changing the temperature in a thermal cycler. A simple temperature change allows multi-step reactions to be accomplished in a single tube with no pipetting steps. A basic thermal cycler can be easily programmed to execute the temperature changes needed to activate and deactivate the enzyme.

Our reagent kits extract high-quality nucleic acids from different sample types including tissue, cultured cells, insects, sperm, bacteria, plants, fungi and a whole host of other tissue types that are suitable for STR, PCR, qPCR, WGA, Next Generation Sequencing (NGS), CRISPR/Cas9 gene editing, cell transfection, and other applications.

The kits come complete with enzymes, buffers, and proprietary additives that are used to help hydrolyze, lyse, chelate, capture, and remove molecules inhibitory to downstream reactions. We make it easy to shop by sample type: from bacteria to plant, cell culture to blood, tissue to saliva, and from insect to virus.



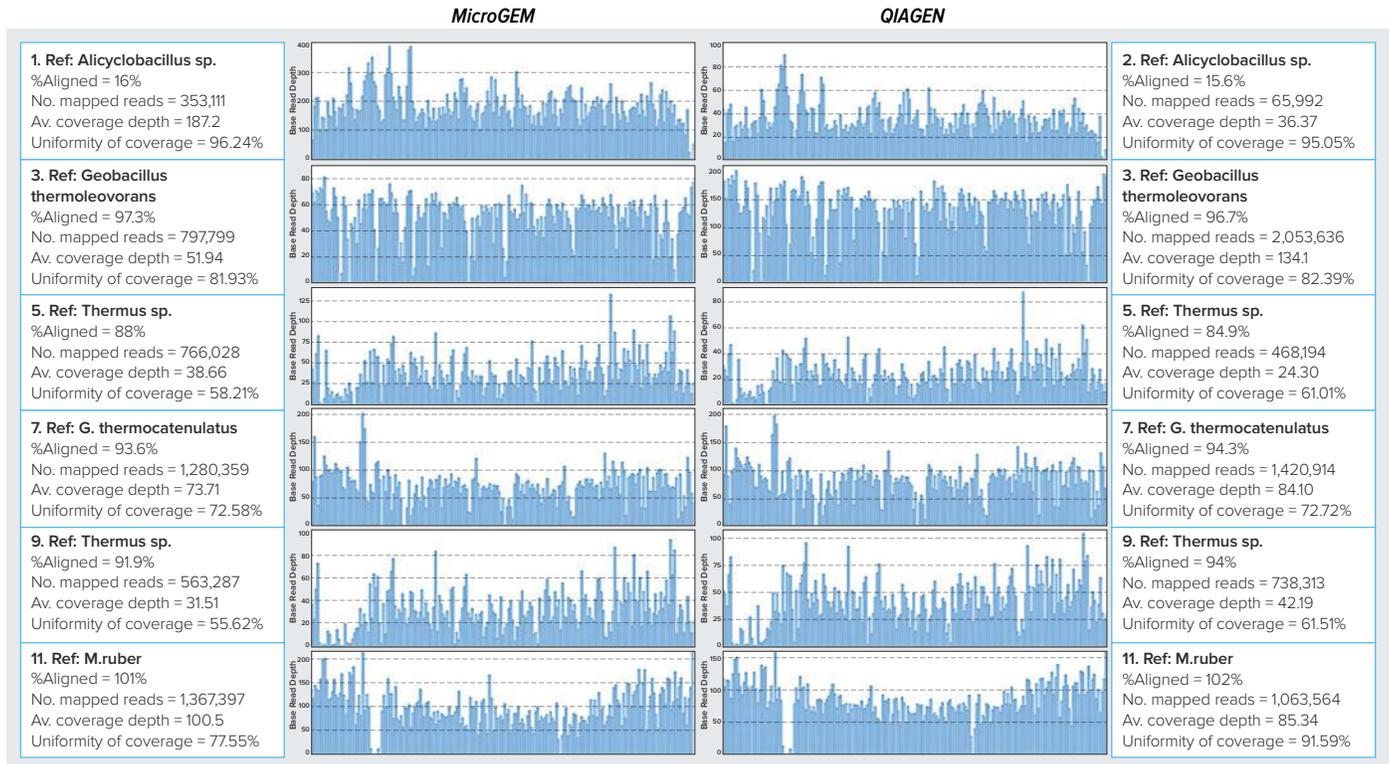
Image shows 100, 500, and 1000 reaction kits



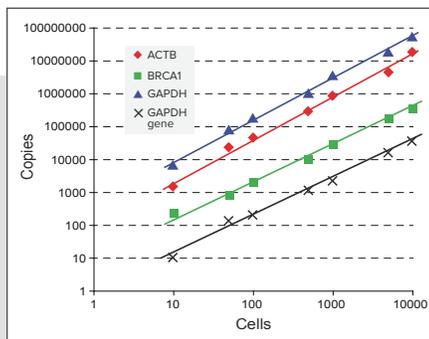
Procedure times for DNA extraction from 24 samples. For the column and the bead methods, the shortest recommended incubation times have been used. Some methods suggest overnight incubations with Proteinase K.

Performance, Simplicity, and Time are the Keys to Robust DNA Extraction

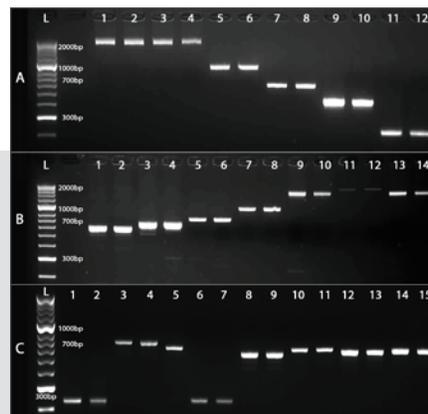
MicroGEM's temperature-driven, single-tube approach consistently produces high-quality extractions with greater speed and simplicity than conventional methods.



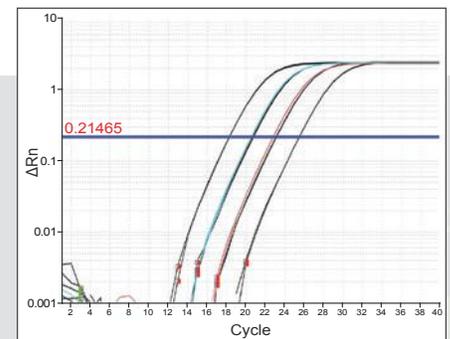
The quality of ion-torrent genome sequences was compared for bacterial DNA extracted using the MicroGEM PDQeX Nucleic Acid Extractor and QIAGEN silica columns. With the PDQeX, the workflow is much faster and easier, and the PDQeX sequence quality is comparable and often better.



The extraction yield using MicroGEM reagents has an excellent linear relationship with the number of cells in the original sample. This result demonstrated that our method is highly reproducible when processing a wide range of cell numbers.



The clean and reproducible bands show that MicroGEM extracted DNA works perfectly for PCR. Agarose gel images showing amplicons generated from plant extractions.



The qPCR plot demonstrates consistent high-quality extractions from both homogenized leaves (blue) and a phytoGEM® card leaf punch (red).

Automating DNA/RNA Extraction Just Got Easier

Our kits can be used with existing laboratory equipment; however, we also offer an automated solution for DNA/RNA extraction. It is ideal for use with challenging samples like plants and soil samples where further removal of inhibitory polyphenols and polysaccharides is required. It's also perfect for fast, easy programmable sample processing.

- Produces single-stranded or double-stranded DNA (ideal for library preparation when performing Next Generation Sequencing (NGS)).
- Extractions in less than 20 minutes.
- Limited pipetting steps.
- Minimal shearing that is perfect for large fragment nanopore sequencing.
- Small footprint takes up less bench space in the laboratory.

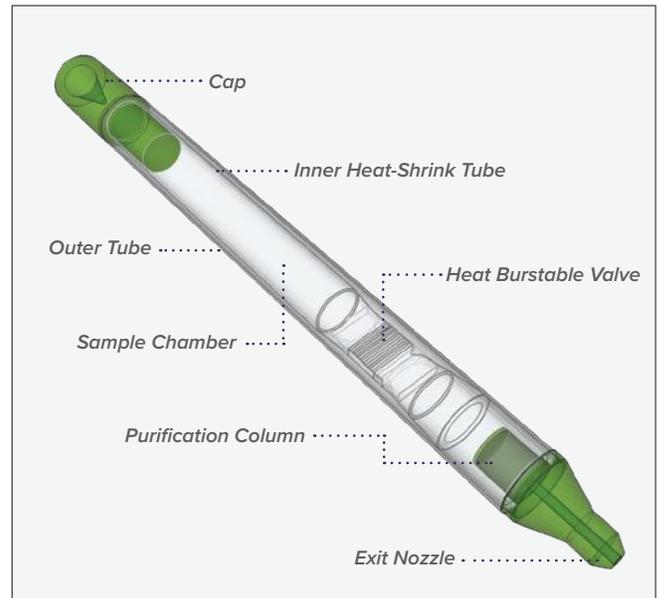
The PDQeX is a three-component system combining:

1. Powerful enzyme-driven extraction chemistry
2. with an innovative extractor cartridge
3. and a temperature control unit.

The extraction chemistry uses a cocktail of thermophilic proteinases and mesophilic cell wall-degrading enzymes that are similar to our reagent kits; but we go a step further by adding automated purification. The temperature-driven extraction is performed within the sample chamber. Temperature activates the proteinase and shrinks the chamber, forcing the extract through a heat-burstable valve and a proprietary matrix housed at the bottom of the cartridge. The purification matrix removes cell debris, inhibitory polyphenols, and polysaccharides.

The single-tube system produces double-stranded DNA without the danger of cross-contamination and it does so in a robust instrument that requires no moving parts. The PDQeX can also be battery operated for in-field experiments.

In addition to the instrument, we also offer accessories to enhance the performance of the PDQeX. See our **Ordering Information & Product Guide** for the kits that work specifically with our PDQeX Nucleic Acid Extractor as well as a list of available PDQeX accessories.



The extractor cartridge made from thermo-responsive polymers not only facilitates extraction but also removes enzyme inhibitors from extracts.



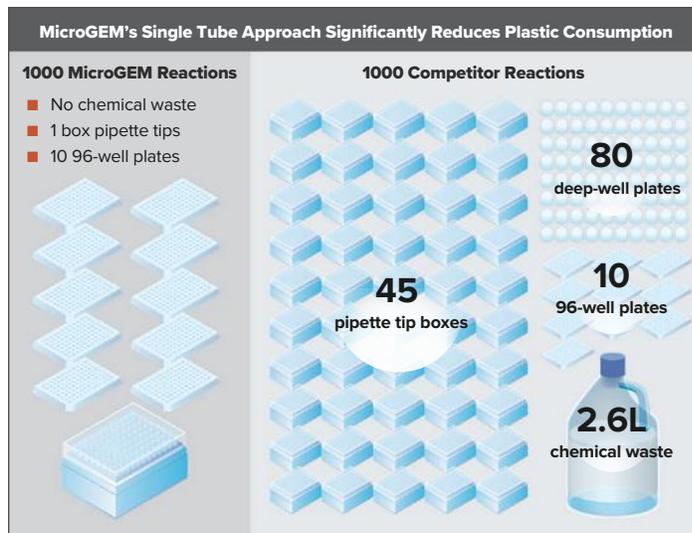
The PDQeX Nucleic Acid Extraction system, weighing in at just 10.6 pounds, is ideal for PCR, qPCR, STR, and NGS applications.

We Think Outside The Box

Our philosophy is to develop innovative approaches to streamline laboratory workflows by:

- reducing steps,
- lowering costs,
- decreasing sample preptimes, and
- ensuring laboratory safety by eliminating harsh chemicals.

It's all possible because we use a single-tube system. After quick sample preparation, all the hard work of lysing cells, destroying nucleases, digesting proteins, and releasing nucleic acids is simply done with our proprietary cocktails of enzymes and heat.



Example of the MicroGEM workflow for processing saliva samples from swabs using a multi-channel pipette and standard thermocycler compared to a competitive method on an automated platform.

Sample preparation – Steps 1 to 3:



Extracts ready for downstream application

Extraction – Steps 4 to 6:



Our process is as easy as mixing the extraction master mix from one of our kits, adding your sample and master mix to PCR tubes, selecting a program on your thermal cycler, and pushing start.

Single-Tube Advantage

- Produces nucleic acids in less than 20 minutes.
- No loss of DNA or RNA; 100% recovery.
- No need for washes.
- No danger of cross contamination.
- Reduced human error.
- Single-tube system keeps things simple, safe, and efficient.
- Handles challenging samples like plant and bacteria.



Leveraging MicroGEM's Single-Tube Approach Across Sample Types

The MicroGEM approach is applied across a wide range of sample types. Specially formulated reagent kits are optimized to address the unique extraction characteristics for samples including:



Cell Culture – *prepGEM* Universal & PDQeX *prepGEM* Universal Kits

When working with cultured cells, it is often necessary to extract DNA from a large number of samples presented in small volumes. *prepGEM* Universal is the perfect extraction solution when working with single cells and low cell numbers.

- Excellent for cell suspensions, adherent cells, cell pellets, and cells that have been obtained through fluorescence-activated cell sorting (FACS) or laser capture microdissection (LCM).
- Speed and 100% DNA recovery work well with gene editing and gene expression applications, including CRISPR/Cas9 genotyping.



Plants – PDQeX *phytoGEM* Kit

Extracting DNA from plants is complicated by tough cell walls that need to be penetrated or removed. *phytoGEM*'s proprietary mesophilic and thermophilic enzymes leverage multi-activation temperatures to degrade cell walls and release DNA, all in a single tube.

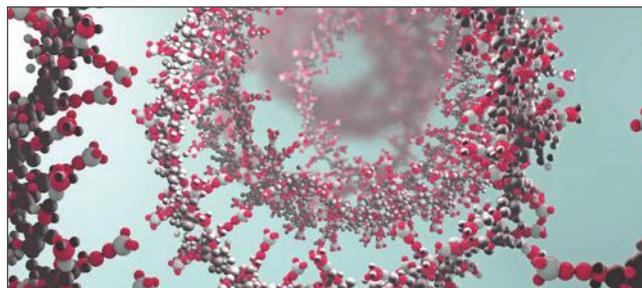
- Fast and simple way to identify plants, plant variety, pathogens, and GMOs from leaf, stems, roots, and fungi.
- Ideal for evaluating the authenticity of exported plant varieties, botanical extracts, and molecular detection of food adulterant.
- Suitable for homogenized or ground samples as well as crushed samples using MicroGEM punch cards.



Bacteria – *prepGEM* Bacteria & PDQeX *prepGEM* Bacteria Kits

When studying microbial cultures, it is important to process samples quickly and gently. Minimal sample preparation, single-tube processing, and gentle lysis ensure that cross-contamination and DNA fragmentation are drastically reduced while preserving the integrity of low abundance species.

- Ideal for studying Gram-positive and Gram-negative bacteria, protozoa, archaea, colonies and liquid cultures, biofilm and mucosal samples, swabs, and metagenomic DNA.
- No transfer steps preserve DNA and improve community representation.
- Minimal handling and pipetting keep DNA intact, perfect for long read sequencing.



RNA – RNAGEM™ Kit

RNA extraction from biological samples is a complicated process due to the presence of ribonuclease enzyme in the cells and tissues that can rapidly degrade the RNA. Our RNAGEM kit provides a single-tube approach and fully-optimized enzymes to extract RNA from a single cell to thousands of cells.

- Suitable for mammalian cell culture, laser capture of micro-cut tissue, and FACS-prepared cell populations.
- Excellent linear relationship to the number of sample cells, even from a single cell.
- The RNase-free enzymes, buffers, and DNase I enable temperature-driven RNA extractions.

Leveraging MicroGEM's Single-Tube Approach Across Sample Types

The MicroGEM approach is applied across a wide range of sample types. Specially formulated reagent kits are optimized to address the unique extraction characteristics for samples including:



Sperm Cells – *forensicGEM*[®] Sperm & PDQeX *forensicGEM* Sperm Kits

Our *forensicGEM* Sperm kit answers the call for a DNA extraction method that ensures reproducible results and a reduced number of steps. This rapid single-tube approach allows for lysis without purification and does not use reducing agents, such as SDS and DTT, that inhibit qPCR and STR analyses.

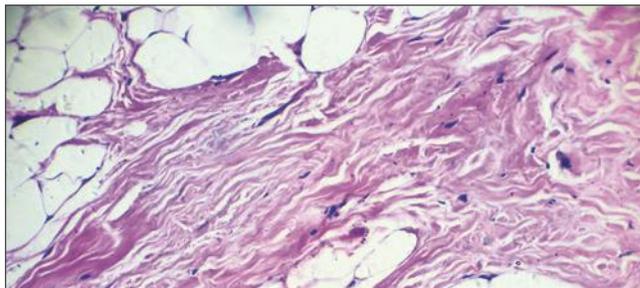
- Rapid DNA extraction from sperm cells, semen, semen stains, and vaginal swabs, even in very small volumes or for samples with very few sperm.
- Ideal for Y chromosome specific real-time PCR and differential extractions.
- Reduced handling ensures yields are maintained and opportunities for contamination and error are reduced.



Saliva – *prepGEM* and *forensicGEM* Universal & PDQeX *prepGEM* and *forensicGEM* Universal Kits

Saliva often plays a critical role in forensic casework as well as genomic, proteomic, metabolomic and bioinformatic studies. Our Universal kits are the ideal solution for extractions from this complex biological sample, especially for high throughput labs using only a small amount of sample.

- Suitable for liquid saliva, swab, stains, and storage card (FTA).
- Ideal for high automation and efficient extractions when quick turnaround time is critical.
- Produces high-quality DNA for comparing genetic differences or similarities of two individuals.



Solid Tissue – *prepGEM* and *forensicGEM* Universal & PDQeX *prepGEM* and *forensicGEM* Universal Kits

Traditional organic extraction processes are based on adding a series of chemicals and detergents to lyse cell membranes, remove inhibitors, and extract DNA. Our single-tube approach involves only two steps: 1) quick sample preparation and 2) closed-tube extraction.

- Ideal for forensic and life science tissue samples including insect, mouse tails, fish fins, ear tags, fat, muscle, dispersed tissue, hair, and tape lifts.
- Perfect for solid tissue extractions with no need for homogenization.
- With no loss of DNA, this approach is suitable for low cell number extractions.



Blood – *prepGEM* and *forensicGEM* Universal & PDQeX *prepGEM* and *forensicGEM* Universal Kits

Producing high-quantity and high-quality DNA from blood samples can be challenging in the face of collection, storage, and handling issues. Our Universal kits address these concerns with limited sample preparation and single-tube processing for rapid, hands-off extractions.

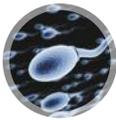
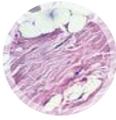
- Suitable for liquid blood, swab, stains, and storage card (FTA).
- Produces high-quality extracts from low volume samples with no loss of DNA.
- Simplifies the handling and processing of blood specimens for life science and forensic applications.

Which Kit is Right For Your Sample Type?

MicroGEM offers a suite of extraction reagents for different sample types. The table below summarizes the common types of samples and makes recommendations for which kits are appropriate for the corresponding sample type.

If your sample type is not shown below, contact us so that we can work with you to provide a specific solution for your sample needs.

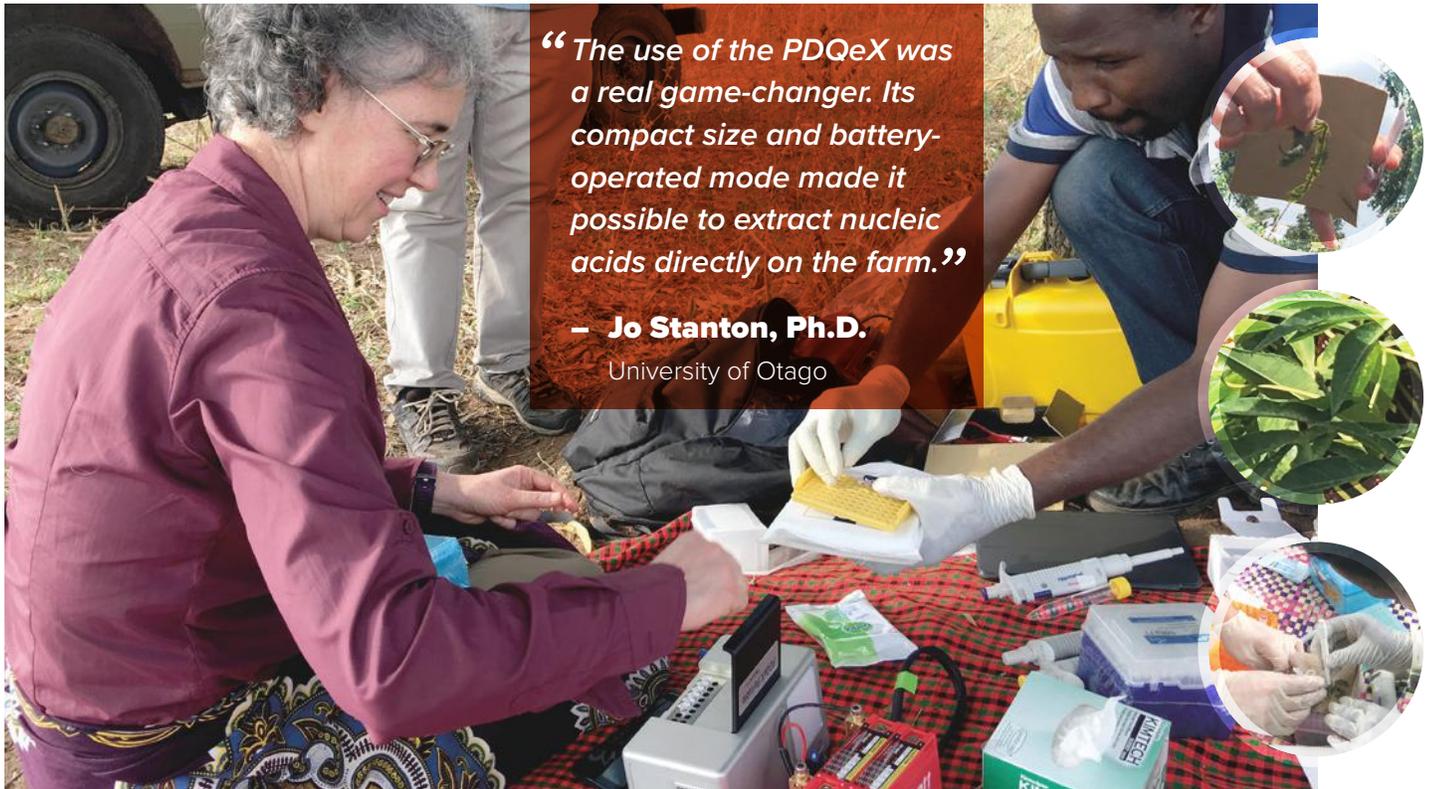
Email us at info@microgembio.com.

Sample Type	Life Sciences	Forensics	With PDQeX Nucleic Acid Extractor	With any PCR Thermal Cycler	Average Sample Prep / Extraction Times*	Recommended Kit
 Cell Culture Cell suspensions, adherent cells, cell pellets, cells obtained by fluorescence-activated cell sorting (FACS) or laser capture microdissection (LCM)	✓			✓	15 min.	<i>prepGEM</i> Universal Kit
	✓		✓		16 min.	PDQeX <i>prepGEM</i> Universal Kit
 Sperm Sperm cells, semen, semen stains, vaginal swabs		✓		✓	20 min.	<i>forensicGEM</i> Sperm Lysis Kit
		✓	✓		25 min.	PDQeX <i>forensicGEM</i> Sperm Kit
 RNA Mammalian cell culture, cells obtained by LCM, cell population prepared by FACS, macrophages	✓			✓	15 min.	RNAGEM Kit
 Blood Liquid (fresh, EDTA, heparin, citrate), swabs, stains, memory card (FTA)	✓			✓	20 min.	<i>prepGEM</i> Universal Kit
	✓		✓		25 min.	PDQeX <i>prepGEM</i> Universal Kit
		✓		✓	20 min.	<i>forensicGEM</i> Universal Kit
		✓	✓	✓	25 min.	PDQeX <i>forensicGEM</i> Universal Kit
 Solid Tissue Solid tissue including animals (scrapes, fat, muscle), mouse and rat tail tips, ear tags, fins, insects, and living tissue sections	✓			✓	25 min.	<i>prepGEM</i> Universal Kit
	✓		✓		27 min.	PDQeX <i>prepGEM</i> Universal Kit
		✓		✓	25 min.	<i>forensicGEM</i> Universal Kit
		✓	✓	✓	27 min.	PDQeX <i>forensicGEM</i> Universal Kit
 Saliva Liquid, buccal swab, stain, memory card (FTA)	✓			✓	15 min.	<i>prepGEM</i> Universal Kit
	✓		✓		16 min.	PDQeX <i>prepGEM</i> Universal Kit
		✓		✓	15 min.	<i>forensicGEM</i> Universal Kit
		✓	✓	✓	16 min.	PDQeX <i>forensicGEM</i> Universal Kit
 Bacteria Gram-positive bacteria, Gram-negative bacteria, protozoa, colonies and liquid cultures, biofilms and mucous membranes, archaea, swabs, metagenomic DNA (soil, stool and water)	✓			✓	37 min.	<i>prepGEM</i> Bacteria Kit
	✓		✓		42 min.	PDQeX <i>prepGEM</i> Bacteria Kit
 Plant Leaves, branches, roots, seeds, plant pathogens, fungi	✓		✓		19 min.	PDQeX <i>phytoGEM</i> Kit

* **PLEASE NOTE:** Sample preparation time is included to show the maximum time required using the MicroGEM kits. Most of this time is hands-free during the extraction process.

Democratizing Molecular Biology

A Story from the Field



The cassava plant, also called yuca, tapioca, or manioc, is grown primarily for food, animal feed, and industrial purposes. This tuber is particularly important to the farmers in Sub Saharan Africa. Especially disheartening is the fact that these plants are prone to infection from the Cassava Mosaic Virus (CMV), which is typically transmitted by the whitefly and through diseased cuttings.

Unfortunately, diagnostic sequencing labs are not readily accessible in these countries. It typically takes over six months to get results from a laboratory in the US or Europe. Without costly cold shipping, the sample is likely to degrade. Worst of all, a long delay in getting vital results means the farmers could lose their crop for that year.

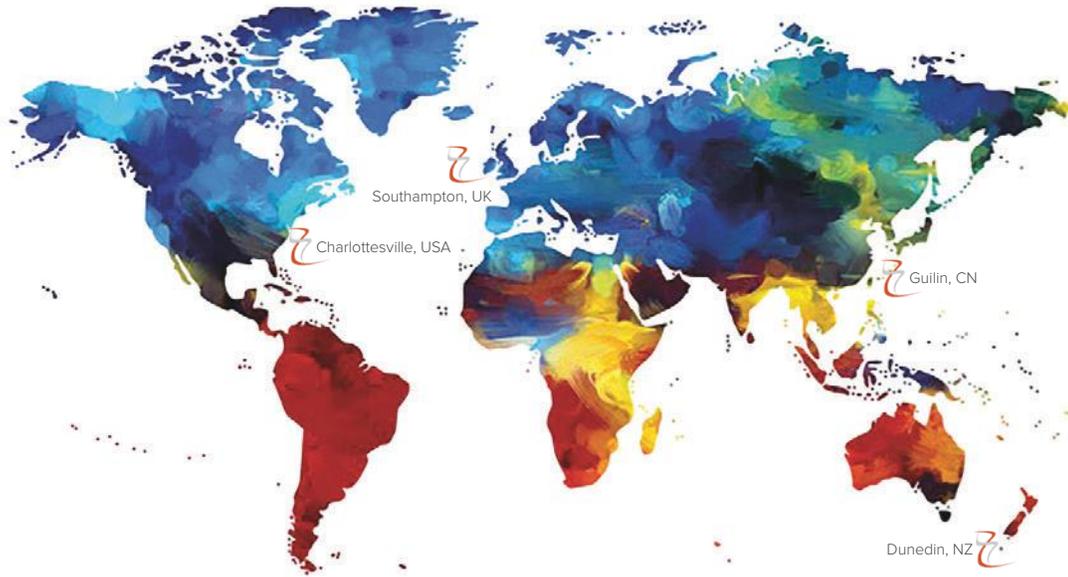
Dr. Jo Stanton and her team recently set out to tackle these challenges in collaboration with the Cassava Virus Action (CVA) Project in Tanzania, Uganda, and Kenya. MicroGEM offered a solution to these farmers and provided DNA/RNA extraction kits and portable instrumentation to the CVA Project. These farmers' lives were transformed by literally extracting nucleic acids in the field in about 20 minutes. Coupled with MinION nanopore sequencing, definitive results were

generated within a few hours without power or refrigeration.

Dr. Stanton's team was able to detect the virus in symptomatic plants, healthy plants with no virus sequence, CMV in a single whitefly, or asymptomatic infected plants that were grown alongside virus-infected plants. The CVA Project generated over one million sequences from three remote locations with an average sequence read length of 1,000 bases in length, adequate for infectious disease diagnostics.

Portability, ease of use, and infield diagnostics provide farmers new options for managing crops currently not available to them. In emergent nations, this technology can ensure both income and food security for subsistence farmers.

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MicroGEM is committed to minimal packaging and a vibrant, sustainable world.