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## RNA reference guide

Sample preparation and  
purification solutions

**ThermoFisher**  
SCIENTIFIC

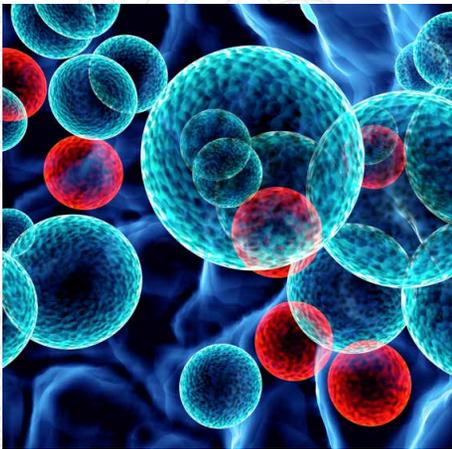
# RNA reference guide

For over three decades and published in over 100,000 publications, scientists have trusted their most precious samples with our innovative and robust RNA isolation and purification products. Our scientists continue to build on this legacy to develop new products and improve results with existing ones.

Development of RNA-related research products was primarily started by the company Ambion in 1989. Ambion™ products are now offered by Thermo Fisher Scientific, joining an innovative portfolio of RNA isolation products that includes organic reagents, columns, lysis buffers, and magnetic beads. Trusted products for RNA isolation include Applied Biosystems™ MagMAX™ kits, Invitrogen™ Cells-to-C<sub>T</sub>™, PureLink™, and *mirVana*™ kits, Invitrogen™ TRIzol™ Reagent, and Invitrogen™ Dynabeads™ isolation technologies.

In biological research, RNA isolation is a crucial step in the journey to discovery. Whichever downstream application you're attempting, you can be confident in our portfolio of high-quality products and methods of extraction for all sample types.

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# Purification and isolation technologies

You have samples to purify. We have the perfect solutions.

Thermo Fisher Scientific offers simple solutions to meet the complex needs of every experiment and research project. Our purification methods range from organic extraction reagents all the way to spin columns and magnetic beads.

**Table 1. Summary of RNA purification technologies.**

Method	Organic extraction	Spin column	Crude lysate	Magnetic beads
<b>Technology</b>	Monophasic solution of phenol and guanidine isothiocyanate	Spin column and reagents optimized for RNA isolation via centrifugation	Lysis buffer and stop solution compatible with reverse transcriptase and PCR applications	Magnetic beads and reagents optimized for RNA isolation
<b>Sample type(s)</b>	Multi-sample—see individual tabs for product details		Cells in culture	Multi-sample—see individual tabs for product details
<b>Technique</b>	RNA isolation achieved through organic extraction and RNA precipitation	Homogenized samples loaded onto spin column; RNA is washed and eluted off column using benchtop centrifuge or vacuum manifold	Cells lysed with lysis buffer compatible with reverse transcriptase and qPCR master mix reactions; no RNA isolation required	Homogenized samples mixed with magnetic beads; beads are washed with wash buffers, and RNA is then eluted off the beads
<b>Purity</b>	Medium	High	Not applicable	Highest
<b>Throughput</b>	Low	Medium to high	Medium to high	Medium to high
<b>Advantages</b>	<ul style="list-style-type: none"> <li>Efficient lysis and isolation</li> <li>Scalable format</li> <li>Great for high-fat and cartilaginous samples</li> <li>30–60 min procedure</li> </ul>	<ul style="list-style-type: none"> <li>Easy to use</li> <li>Processing of many sample types and volumes</li> <li>Specialized equipment not required</li> <li>High yield and purity</li> <li>20 min procedure</li> <li>Isolates true total RNA, including miRNA</li> </ul>	<ul style="list-style-type: none"> <li>7 min sample prep</li> <li>Addition-only workflow—transfer to column or bead not required</li> <li>Process 10–100,000 cells with single protocol</li> <li>RNA isolation not required</li> <li>Highest reproducibility and sensitivity</li> <li>Complete kit contains lysis reagents, reverse transcriptase, and qPCR master mix</li> <li>1-step and 2-step workflows available</li> </ul>	<ul style="list-style-type: none"> <li>Higher-efficiency washes with bead movement</li> <li>No column means no risk of clogging</li> <li>Fully scalable sample prep to process low and high sample inputs</li> <li>High yield and efficiency</li> <li>High throughput—friendly</li> <li>Automatable on magnetic particle handlers</li> </ul>
<b>Difficulties</b>	<ul style="list-style-type: none"> <li>Novice users find phase separation challenging to master</li> <li>Hazardous—chemical fume hood required</li> <li>Challenging to process large number of samples simultaneously</li> </ul>	<ul style="list-style-type: none"> <li>Manual process</li> <li>Processing individual columns often challenging to handle</li> </ul>	<ul style="list-style-type: none"> <li>Limited to cells in culture and blood</li> </ul>	<ul style="list-style-type: none"> <li>Magnet stand required</li> <li>Instrument required for automatic processing</li> </ul>
<b>Recommended for</b>	Most sample types, but best for extraction of RNA from high-fat tissues (such as brain and mammary tissue) or infectious samples	Most RNA isolation needs	High-throughput gene expression screening from cells in culture	Medium- to high-throughput or automatic sample prep processing

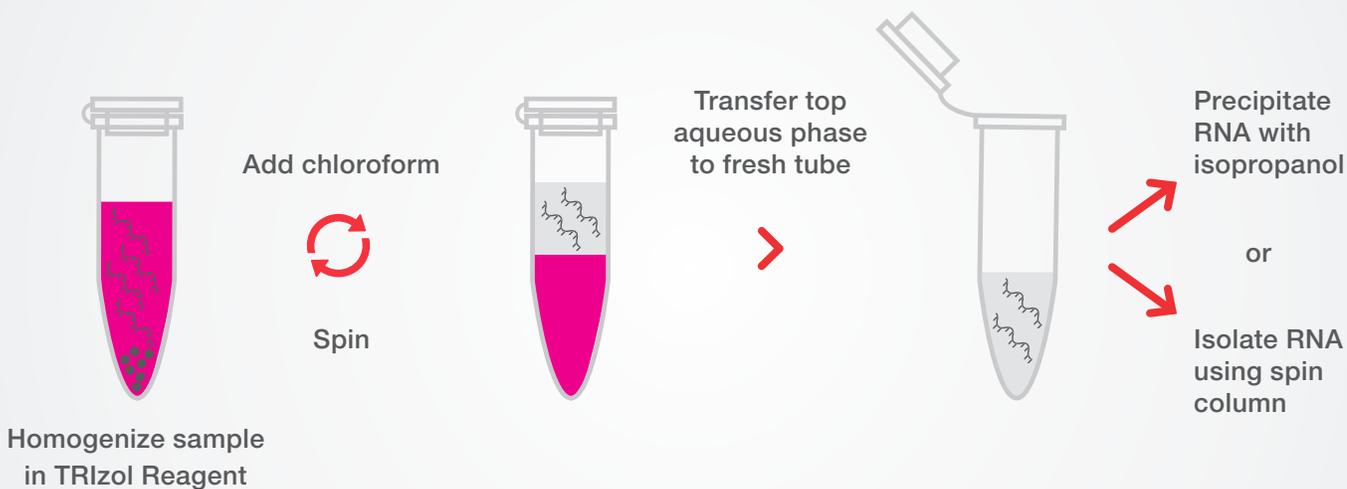
# Organic extraction

## Total RNA isolation with TRIzol Reagent

Get in the hood with the most trusted and referenced reagent for isolating high-quality, intact RNA—Invitrogen™ TRIzol™ Reagent. This reagent allows sequential precipitation of RNA, DNA, and protein from a single sample. After homogenizing the sample with TRIzol Reagent, chloroform is added, and the homogenate separates into a clear upper aqueous layer containing RNA, an interphase layer, and a pink lower organic layer containing the DNA and protein. RNA is precipitated from the upper aqueous layer with isopropanol. DNA is precipitated from the interphase and organic layers with ethanol. Protein is precipitated from the phenol–ethanol supernatant with isopropanol. The precipitated RNA, DNA, or protein is washed to remove impurities, and then resuspended for use in downstream applications.



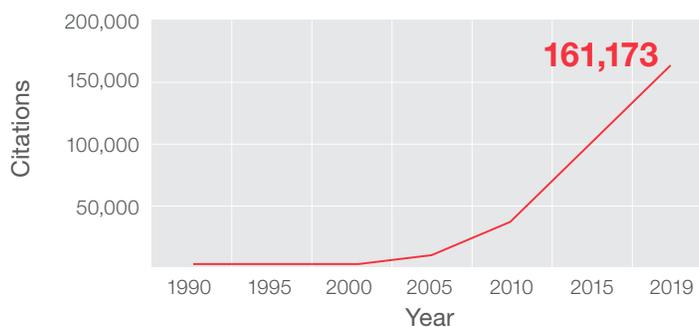
## TRIzol Reagent in action



## Trust in TRIzol Reagent

### Features of TRIzol Reagent:

- Unparalleled lysis capability
- Single-step protocol, monophasic solutions (phenol and guanidine isothiocyanate)
- Flexible formulations for difficult samples
- Low genomic DNA (gDNA) contamination of isolated RNA
- Can purify DNA, RNA, and protein all from the same sample

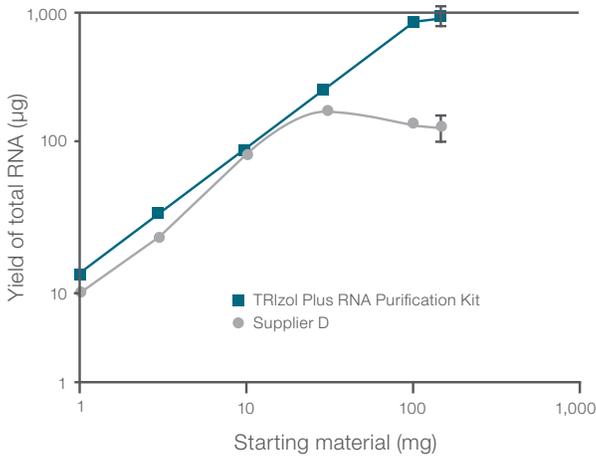


**Figure 1. TRIzol Reagent is the most cited organic reagent for nucleic acid isolation.** Citations gathered from 1990 to 2019 according to PubMed records ([ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)).

### Did you know?

The “TRI” in TRIzol stands for total RNA isolation. It also signifies the three layers that form during sample extraction, which allow RNA, DNA, and protein to be purified from a single source.

# TRIzol Plus RNA Purification Kit



**Figure 2. High yield of RNA using the Invitrogen™ TRIzol™ Plus RNA Purification Kit.** Isolate more RNA faster by combining the lysis capability of TRIzol Reagent with the convenient RNA extraction technology of silica spin columns of the Invitrogen™ PureLink™ RNA Mini Kit .



**Pro tip:**  
The TRIzol Plus RNA Purification Kit combines TRIzol Reagent with spin column technology, and can isolate up to 10 times more RNA than other purification systems.

## TRIzol Reagent workflow:



**Figure 3. Safe isolation of RNA from blood samples for gene expression analysis.** Invitrogen TRIzol and TRIzol LS Reagents have been demonstrated to chemically inactivate infectious viruses such as Ebola virus (EBOV) for improved safety.\* With TRIzol reagents, RNA purified from blood samples is ready for a variety of RNA analyses.

\* Reference: *Viruses* (2018) 10:126.

For additional resources on the workflow featured above, use your mobile phone's camera app to scan the QR codes below. Gain immediate access to:

RT-PCR kits and reagents



PCR and real-time PCR solutions brochure



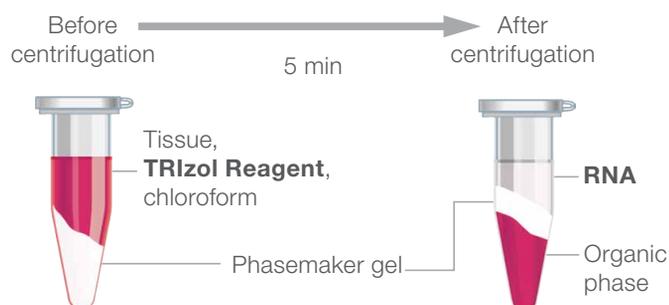
## TRI these options

Table 2. Comparison of TRIzol products offered for manual (not high-throughput) RNA purification.

Product	TRIzol Reagent	TRIzol LS Reagent	TRIzol Plus RNA Purification Kit	TRIzol Max Bacterial RNA Isolation Kit
<b>Product size</b>	100 mL (Cat. No. 15596026) 200 mL (Cat. No. 15596018)	100 mL (Cat. No.10296010) 200 mL (Cat. No. 10296028)	50 preps (Cat. No. 12183555)	100 preps (Cat. No. 16096020) 200 preps (Cat. No. 16096040)
<b>Time</b>	1 hr			
<b>Sample input</b>	<ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Blood</li> <li>• Cells</li> <li>• Plant samples</li> <li>• Tissue (including fat and cartilage)</li> <li>• Viral samples</li> <li>• Yeast</li> </ul>	<ul style="list-style-type: none"> <li>• Blood</li> <li>• Liquid samples (e.g., serum)</li> <li>• Viral samples</li> </ul>	<ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Blood</li> <li>• Cells</li> <li>• Plant samples</li> <li>• Tissue (including fat and cartilage)</li> <li>• Viral samples</li> <li>• Yeast</li> </ul>	<ul style="list-style-type: none"> <li>• Bacteria</li> </ul>
<b>Final product</b>	<ul style="list-style-type: none"> <li>• Total RNA, including long noncoding RNA (lncRNA)</li> <li>• Messenger RNA (mRNA)</li> <li>• MicroRNA (miRNA) and others</li> <li>• DNA</li> <li>• Protein</li> </ul>			
<b>Recommended for</b>	<ul style="list-style-type: none"> <li>• Gene expression</li> <li>• Reverse transcription quantitative PCR (RT-qPCR)</li> <li>• Next-generation sequencing (NGS)</li> <li>• Microarray analysis</li> <li>• Cloning</li> <li>• Northern blotting</li> <li>• Nuclease protection assays</li> <li>• cDNA library construction</li> </ul>			

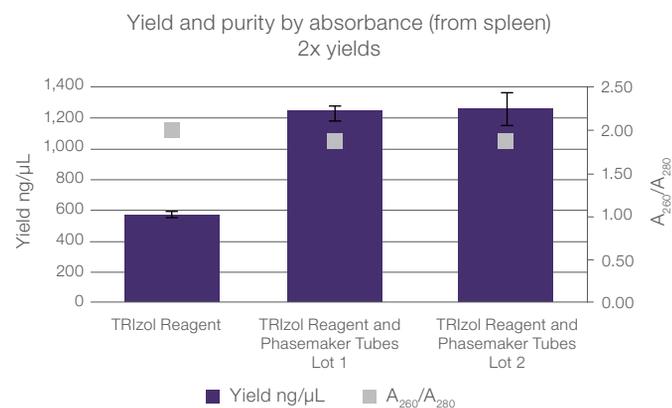
# Meet a great match for TRIzol reagents: Phasemaker Tubes

Using TRIzol reagents just got simpler, thanks to a new best friend. Invitrogen™ Phasemaker™ Tubes create a tight, durable seal between the aqueous and organic phase of your TRIzol mix, allowing you to easily pipet off the RNA phase.



## Benefits of using Phasemaker Tubes include:

- **Higher yield**—increase recovery by as much as 30%
- **Ease of use**—simple integration of PhaseMaker Tubes into the TRIzol Reagent protocol
- **Ready-to-use convenience**—comes dispensed in 2 mL tubes
- **Increased throughput**—stable gel seal allows you to maximize the number of samples per run without losing distinct phase separation



**Figure 4. TRIzol Reagent and Phasemaker Tubes.** Phasemaker Tubes create a durable seal between aqueous and organic phases, allowing you to maximize the number of samples per run without losing phase separation, and easily pipet off the RNA phase with minimal loss.



### Pro tip:

Even if the tube is dropped after centrifugation, the TRIzol Reagent phases remain separated; don't waste time centrifuging again.

## TRI it all for yourself

### Ordering information

Product	Quantity	Cat. No.
TRIzol Reagent	100 mL	15596026
	200 mL	15596018
TRIzol LS Reagent	100 mL	10296010
	200 mL	10296028
TRIzol Plus RNA Purification Kit	50 preps	12183555
TRIzol Max Bacterial RNA Isolation Kit	100 preps	16096020
	200 preps	16096040
Phasemaker Tubes	100 tubes	A33248

# Column purification



## Spin down for what—flexible, easy, and reliable RNA isolation

Our PureLink silica columns stand out among the crowd, with 6x more sample input capacity than other suppliers' products and the ability to process various sample types in 20 min. The best part is that column kits are available for total RNA, mRNA, miRNA, small RNA, viral RNA, and sequence-specific RNA extractions.

### A tried and true spin on RNA purification

Samples are lysed in a guanidine isothiocyanate lysis buffer designed to efficiently liberate proteins and other debris from the RNA while maintaining the integrity of the RNA during the isolation steps. Special nuclease-free reagents are combined with certified RNase-free silica membranes in a spin column to enable a safe and easy procedure. Once the lysate has been passed through the silica membrane using a benchtop centrifuge, the membrane is then washed to remove contaminants such as proteins, salts, detergents, and other impurities. After the column is washed, RNA is eluted with RNase-free water and is ready to use directly for a variety of downstream analytical applications.

### Did you know?

Most analytical methods to isolate RNA do not require the removal of contaminating gDNA. For qPCR applications, Invitrogen™ TaqMan® Gene Expression Assays designed to detect mRNA or PCR primers that span exon–intron boundaries can be used without the additional DNase treatment of RNA. Save your time and research budget by using the right method for your sample preparation and analysis.

If removal of residual DNA is necessary, the PureLink RNA Mini Kit offers on-column treatment to save time and precious RNA samples, or post-isolation DNase treatment with the Invitrogen™ PureLink™ DNase Set. For more information on DNase offerings, explore the “Sample prep essentials” tab.

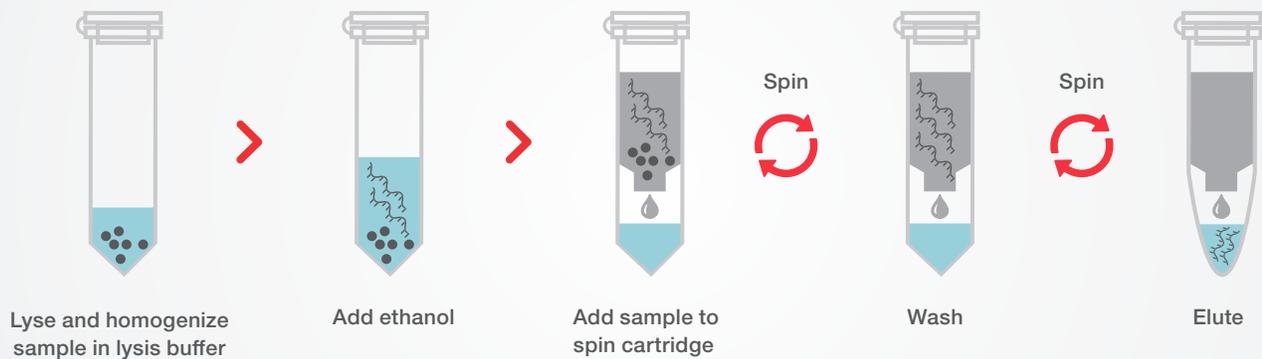
### Pro tip:

Combine TRIzol Reagent with spin column filter purification for exceptionally pure RNA.

### Silica or glass fiber membrane purification

- Silica-membrane (also known as glass fiber) filters allow fast and easy RNA purification, resulting in pure RNA that can be used in most applications.
- Guanidine isothiocyanate lysis and wash buffers combined with RNase-free spin columns help protect RNA during isolation.

## Let your sample prep spin



**Figure 5. Spin column purification protocol.** RNA purification is easy with the spin columns used in our Invitrogen™ PureLink™ and Thermo Scientific™ GeneJET™ purification kits. Simply lyse, bind, wash, and elute your samples.

## Take a spin with PureLink purification kits

### PureLink RNA Mini Kit

Process sample inputs from 5 to 200 mg of animal or plant tissue or from  $0.5 \times 10^6$  to  $0.5 \times 10^8$  tissue culture cells with one spin column in 20 min.

- Isolate up to 1,000  $\mu\text{g}$  of total RNA\* with one column
- Very low residual DNA carryover
- Flexible, optional on-column or post-isolation DNase treatment with the Invitrogen™ PureLink™ DNase Set (Cat. No. 12185010)

\* All RNA longer than 18 nucleotides.



### Pro tip:

Sample type doesn't matter with the PureLink RNA Mini Kit. Tissue, blood, bacteria, yeast, and plant cells—do it all with just one kit using the optimized protocols included for each sample type.

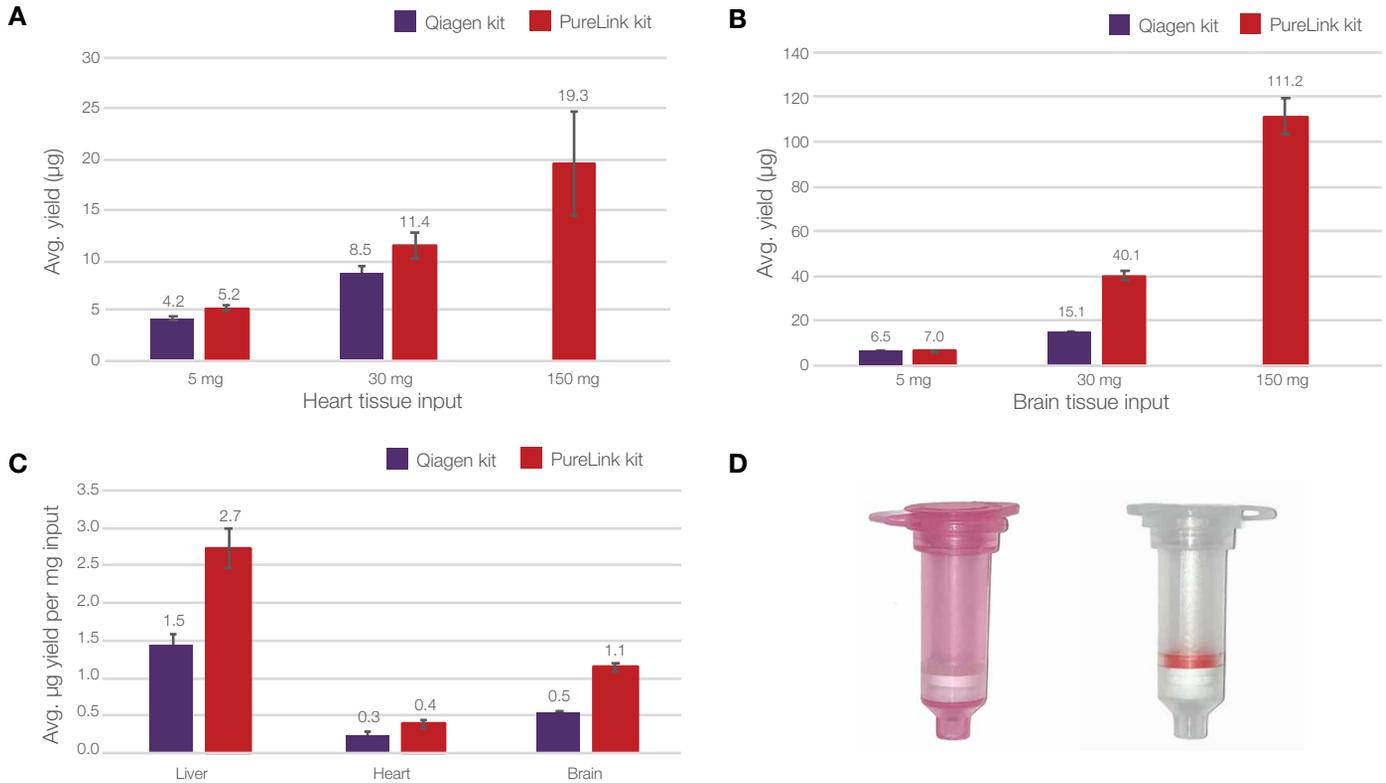
### Did you know?

One PureLink RNA Mini Kit can process the same amount of sample as one Qiagen RNeasy™ Mini Kit and one RNeasy™ Midi Kit combined. The larger column capacity enables a broader range of sample input to meet all your RNA isolation needs with one kit.

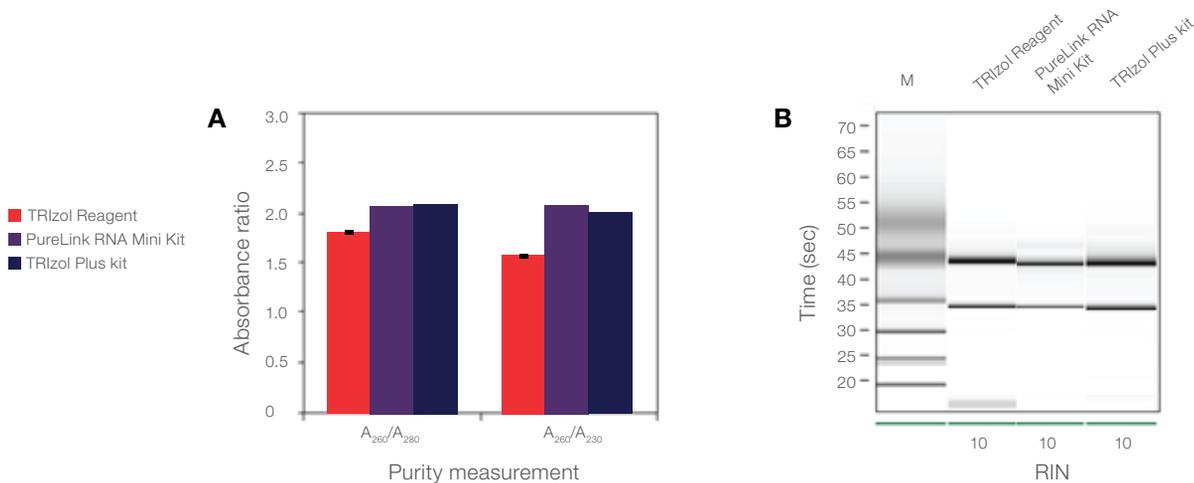
## A closer look

RNA yields were determined by analysis on the Invitrogen™ Qubit™ 4 Fluorometer, which can be used to specifically measure intact RNA but no other nucleic acids. The Qiagen kits have a recommended sample input of up to

30 mg, while the PureLink kit enables processing of more than 150 mg of tissue. For 5 mg and 30 mg inputs, the PureLink kit delivered higher RNA yields than the Qiagen kit, for all three tissue types analyzed.



**Figure 6. Comparison of RNA yields from mouse liver, heart, and brain tissue. (A–C)** For all tissue types, the PureLink kit yielded more RNA than the Qiagen kit. For liver and brain tissue, the PureLink kit recovered approximately twice as much RNA as the Qiagen kit. **(D)** The PureLink column (right) has a larger bed than the Qiagen column (left), supporting higher input capacity.



**Figure 7. Purity and RNA integrity number (RIN) values for isolated RNA. (A)** TRIZOL Reagent, the PureLink RNA Mini Kit, and the TRIZOL Plus kit were used to isolate RNA, and purity measurements were compared. **(B)** RNA integrity analysis on the Agilent Bioanalyzer™ instrument and the RIN value can be used to evaluate RNA quality. High RIN values and intact RNA were obtained in the RNA sample preparation process using these products.



### **mirVana miRNA Isolation Kit**

It's the little things that count. The Invitrogen™ *mirVana*™ miRNA Isolation Kit combines TRIzol reagent with spin column technology to isolate total RNA ranging in size from kilobases down to 10 bases. This kit uses a rapid procedure to isolate small RNAs from tissues and cells, and contains sufficient reagents and consumables for either 40 isolations of total RNA (including small RNAs) or 20 separate large and small RNA fractions.

#### **Features of this kit:**

- Ideal for miRNA, siRNA, small hairpin RNA (shRNA), small nuclear RNA (snRNA) analysis
- Efficient isolation of total RNA containing small RNA
- Alternate protocol to enrich small RNA (<200 nt) will increase sensitivity in downstream small RNA analyses
- Simple 30 min procedure
- Compatible with virtually all cell and tissue types
- Available for purchase with and without phenol

#### **Pro tip:**

Combine TRIzol Reagent with spin-column filter purification for exceptionally pure RNA.

#### **Did you know?**

Flexible, optional on-column or post-isolation DNase treatment is available with the PureLink DNase Set for easy removal of residual DNA.



### **RecoverAll Multi-Sample RNA Isolation Kit for special RNA species**

Precious samples, such as cancer biopsies, are often preserved using formalin-fixed paraffin-embedded (FFPE) methods, which degrades RNA. The biological information locked within these samples is still recoverable without further RNA degradation using the Invitrogen™ RecoverAll™ Multi-Sample RNA/DNA Isolation Workflow kit.

#### **Features of this kit:**

- Recovers RNA and DNA in separate eluates or in a single eluate from the same FFPE section
- RecoverAll chemistry maximizes the yield of RNA from FFPE samples without degrading RNA
- A single spin column can tolerate even very large amounts of paraffin (up to four 20 µm sections per reaction)

## Put a spin on your workflow

Our spin columns assist in a variety of downstream applications.



**Figure 8. Example workflow for protein expression analysis using RNA isolated using the PureLink RNA Mini Kit.** RNA purified from tissue culture cells using the PureLink RNA Mini Kit is ready for RT-PCR and subsequent downstream analysis by quantitative PCR using gold-standard Applied Biosystems™ TaqMan® Gene Expression Assays.

For additional resources on the workflow featured above, use your mobile phone’s camera app to scan the QR codes below. Gain immediate access to:

PCR and real-time PCR solutions brochure for more information on our thermal cyclers, real-time PCR instruments, and the first-class plastics, reagents, and services that go with them

More information on our Applied Biosystems™ QuantStudio™ instruments



**Table 3. Selection guide for column-based RNA purification products.**

Product	PureLink RNA Mini Kit	PureLink Viral RNA/DNA Mini Kit	<i>mirVana</i> miRNA Isolation Kit	RNAqueous Total RNA Isolation Kit	RecoverAll Total Nucleic Acid Isolation Kit
<b>Isolation technology</b>	Silica or glass fiber spin column	Silica or glass fiber spin column	Organic extraction and spin column	Silica or glass fiber spin column	Silica or glass fiber spin column
<b>Product size</b>	10 preps 50 preps 250 preps	50 preps	40 preps	50 preps	40 preps
<b>Time</b>	20 min	45 min	30 min	25–35 min	75 min
<b>Sample input</b>	<ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Blood</li> <li>• Cells</li> <li>• Plant</li> <li>• Tissue</li> <li>• Yeast</li> </ul>	<ul style="list-style-type: none"> <li>• Plasma</li> <li>• Serum</li> <li>• Cerebrospinal fluid</li> <li>• Cell-free fluids</li> </ul>	<ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Cells</li> <li>• Plant</li> <li>• Tissue</li> <li>• Virus</li> <li>• Yeast</li> </ul>	<ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Cells</li> <li>• Plant</li> <li>• Tissue</li> <li>• Virus</li> <li>• Yeast</li> </ul>	<ul style="list-style-type: none"> <li>• FFPE and other fixed samples</li> </ul>
<b>Final product</b>	Total RNA	gDNA	Total RNA, transcriptome RNA, miRNA, siRNA, snRNA	Total RNA	Genomic DNA, total RNA, miRNA
<b>Recommended for</b>	<ul style="list-style-type: none"> <li>• Microarray analysis</li> <li>• Next-generation sequencing (NGS)</li> <li>• Northern blotting</li> <li>• Nuclease protection assays</li> <li>• qPCR</li> <li>• RT-PCR</li> <li>• cDNA library construction</li> </ul>	<ul style="list-style-type: none"> <li>• Cloning</li> <li>• PCR</li> <li>• qPCR</li> <li>• RT-PCR</li> <li>• Sequencing</li> <li>• NGS</li> <li>• Southern blotting</li> <li>• Northern blotting</li> </ul>	<ul style="list-style-type: none"> <li>• miRNA analysis</li> <li>• NGS</li> <li>• Microarray analysis</li> <li>• qPCR</li> <li>• RT-PCR</li> </ul>	<ul style="list-style-type: none"> <li>• Microarray analysis</li> <li>• NGS</li> <li>• Northern blotting</li> <li>• Nuclease protection assays</li> <li>• qPCR</li> <li>• RT-PCR</li> <li>• cDNA library construction</li> </ul>	<ul style="list-style-type: none"> <li>• NGS</li> <li>• Northern blotting</li> <li>• PCR</li> <li>• qPCR</li> <li>• RT-PCR</li> <li>• Southern blotting</li> <li>• cDNA library construction</li> <li>• miRNA analysis</li> </ul>

### Ordering information

Product	Quantity	Cat. No.
<i>mirVana</i> miRNA Isolation Kit, with phenol	40 preps	AM1560
<i>mirVana</i> miRNA Isolation Kit, without phenol	40 preps	AM1561
PureLink RNA Micro Scale Kit	50 preps	12183016
	10 preps	12183020
PureLink RNA Mini Kit	50 preps	12183018A
	250 preps	12183025
PureLink <i>Pro</i> 96 Viral RNA/DNA Purification Kit	4 plates	12280096A
PureLink <i>Pro</i> 96 Total RNA Purification Kit	4 plates	12173011A
PureLink™ Viral RNA/DNA Mini Kit	50 preps	12280050
	120 preps	A26069
RecoverAll Multi-Sample RNA/DNA Isolation Workflow	200 preps	A26135
RecoverAll Total Nucleic Acid Isolation Kit for FFPE	40 preps	AM1975
RNAqueous™ Total RNA Isolation Kit	50 preps	AM1912

Find out more at [thermofisher.com/rnaextraction](https://thermofisher.com/rnaextraction)

# Crude lysate purification



## Cells to C<sub>t</sub> values

Are RNA isolation workflows slowing you down? Skip them. Prepare your tissue culture samples for gene expression analysis in only 7 min without isolating a single RNA. Invitrogen™ Cells-to-C<sub>t</sub>™ kits enable high-throughput and high-sensitivity cell-based gene expression analysis without robots, column or bead washing, or heat- or labor-intensive RNA isolations. All Cells-to-C<sub>t</sub> kits come complete with cell lysis reagents, reverse transcriptases, and Applied Biosystems™ qPCR master mixes suitable for TaqMan Gene Expression Assays or SYBR™ Green PCR primer methods. Additionally, 1-step and 2-step RT-qPCR and single-cell Cells-to-C<sub>t</sub> kits are available to suit a variety of gene expression needs.

## The secret to lysate-based gene expression

The advanced Cells-to-C<sub>t</sub> Lysis Solution and Stop Solution are the keys that unlock lysate-based gene expression analysis. The lysis buffer liberates RNA but does not interfere with downstream analysis.

## Cells-to-C<sub>T</sub> reverse transcriptase and master mix optimization

Not all reverse transcriptases and master mixes work well with crude lysates. Our R&D scientists for the Cells-to-C<sub>T</sub> products tested an arsenal of reverse transcriptases and Applied Biosystems™ master mixes with the Cells-to-C<sub>T</sub> lysis components to determine the optimal combination suitable for the designated RT-qPCR application. PCR efficiency, maximum crude lysate input, PCR inhibition, reproducibility, and linear amplification from 10 cells to 100,000 cells were among the criteria used to determine the final, optimized Cells-to-C<sub>T</sub> kit components. These optimized reagents were then put through a manufacturing quality control process, including verification and validation testing, to produce products that perform as expected. Thus, you can confidently choose the Cells-to-C<sub>T</sub> kit that best suits your needs and eliminate the need to perform the PCR efficiency and inhibition testing yourself.

### Did you know?

The TaqMan Fast Advanced Cells-to-C<sub>T</sub> Kit was designed specifically for TaqMan Gene Expression Assays.

## TaqMan Fast Advanced Cells-to-C<sub>T</sub> Kit\*

- No tedious RNA purification—no columns, heating, centrifugation, or sample transfer
  - The same proprietary Lysis Solution and Stop Solution as in the original TaqMan Gene Expression Cells-to-C<sub>T</sub> Kit
  - Extraordinary ease and speed—prepare 96 samples for RT-qPCR typically in <10 min
  - Superior performance—designed for consistent accuracy, reproducibility, and sensitivity with 10–100,000 cells
  - Premium validated kit workflows—complete sets of reagents preoptimized to work efficiently right out of the box
- Additional probe for superior specificity for detecting targets
  - Detect virtually any gene product, with more than 2 million predesigned assays
  - Affordable assays for nearly every human, mouse, and rat gene in the RefSeq database
  - TaqMan Assays available for 28 species and some pathogens

As new reverse transcriptases and qPCR master mixes have become available, the Cells-to-C<sub>T</sub> product line has added new kits with faster and more sensitive reverse transcriptases and master mixes. The newest Cells-to-C<sub>T</sub> kits enable users to process a 96-well plate of cells all the way to C<sub>T</sub> values in 80 min with the Applied Biosystems™ TaqMan® Fast Advanced Cells-to-C<sub>T</sub> Kit, or 90 min with the Invitrogen™ SYBR™ Green Fast Advanced Cells-to-C<sub>T</sub> Kit. Because of the updated reverse transcriptases and qPCR master mixes, users also report better sensitivity compared to the first-generation Cells-to-C<sub>T</sub> kits.

### Pro tip:

For a more cost-conscious solution, design your own primers and use the SYBR Green Fast Advanced Cells-to-C<sub>T</sub> Kit.



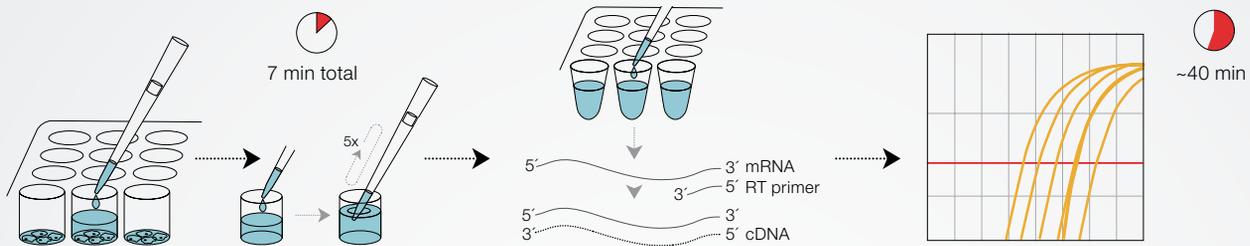
\* The Cells-to-C<sub>T</sub> lysis components such as the Stop Solution and reverse transcriptase enzymes can be purchased in 2,500-reaction bulk pack sizes for larger projects.

### SYBR Green Fast Advanced Cells-to-C<sub>T</sub> Kit\*

- No tedious RNA purification—no columns, heating, or centrifugation
- The same proprietary Lysis Solution and Stop Solution as in the original TaqMan Gene Expression Cells-to-C<sub>T</sub> Kit
- Extraordinary ease and speed—96 samples for RT-qPCR typically in <10 min
- Superior performance—designed for consistent accuracy, reproducibility, and sensitivity with 10–100,000 cells
- Premium validated kit workflows—complete sets of reagents preoptimized to work efficiently right out of the box
- High specificity for detecting targets

\*The Cells-to-CT lysis components such as the Stop Solution and reverse transcriptase enzymes can be purchased in 2,500-reaction bulk pack sizes for larger projects.

### Cells-to-C<sub>T</sub> analysis in action



#### Cell Lysis + Stop Solution

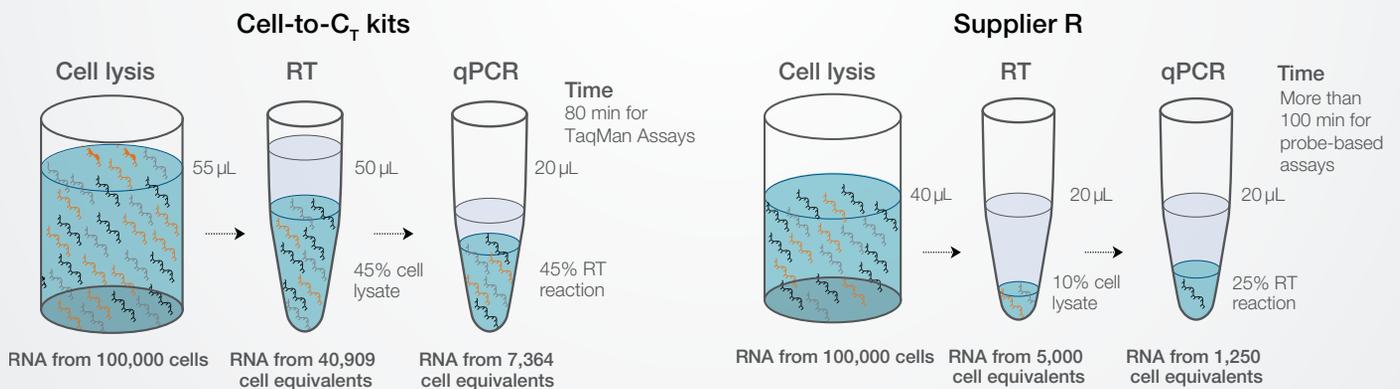
1. Remove culture medium and wash cells with PBS.
2. Dilute DNase into Lysis Solution (optional).
3. Add Lysis and Stop Solutions sequentially. Mix 5 times after each addition.

#### Reverse transcription

Assemble an RT master mix and run RT thermal cycler program.

#### qPCR: TaqMan or SYBR Green Assay

Assemble a PCR cocktail, add cDNA, and run the reaction in a qPCR instrument.



**Figure 9. Comparison of workflows—Cells-to-C<sub>T</sub> kit vs. other supplier's product.** Compared to supplier R's product, the Cells-to-C<sub>T</sub> kits are able to isolate more RNA from the same starting sample amount in less time.

### Innovation—it's in our RNA

The Cells-to-C<sub>T</sub> Stop Solution allows for greater sample input in downstream RT and qPCR reactions, greatly increasing sensitivity for detecting rare targets. Both TaqMan and SYBR Green Fast Advanced Cells-to-C<sub>T</sub> Kits use the Stop Solution, providing excellent sensitivity

with a very fast workflow. The TaqMan Fast Advanced Cells-to-C<sub>T</sub> kits can process 96 or 384 wells at once; the experimental workflow only takes about 10 min for a 96- or 384-well plate. Products from other suppliers use low pH and dilution in their workflows, which restrict how much cell lysate can be used in downstream steps.

## Cells-to-C<sub>T</sub> workflow



Cell culture with Gibco products



Cell lysis using the TaqMan Fast Advanced Cells-to-C<sub>T</sub> Kit



qPCR using the QuantStudio 7 Pro Real-Time PCR System



Archive cDNA

**Figure 10. Cells-to-C<sub>T</sub> kits allow for simple and efficient gene expression analysis by RT-qPCR.** The Cells-to-C<sub>T</sub> kits use one workflow for RT-qPCR analysis directly from cultured cells. Choosing a 2-step kit also enables you to archive cDNA for downstream applications such as cloning.

For additional resources on the workflow featured above, use your mobile phone's camera app to scan the QR codes below. Gain immediate access to information on QuantStudio instruments and RT-PCR products.



Table 4. Cells-to-C<sub>T</sub> product selection guide.

PCR method	1-step RT-qPCR		2-step RT-qPCR		
Product	Cells-to-C <sub>T</sub> 1-Step TaqMan Kit*	Cells-to-C <sub>T</sub> 1-Step Power SYBR™ Green Kit**	TaqMan Fast Advanced Cells-to-C <sub>T</sub> Kit	TaqMan Gene Expression Cells-to-C <sub>T</sub> Kit	SYBR Green Fast Advanced Cells-to-C <sub>T</sub> Kit
Specificity	High	Medium	High	Medium	High
Reproducibility	High	Medium	High	Medium	High
Sensitivity	20% of lysate represented; 1–10 copies	13.5% of lysate represented	20% lysate	20% lysate	20% lysate
Product size	20 preps 100 preps 400 preps		40 reactions 100 reactions 400 reactions		
Lysate prep time	7 min prep				
Total workflow time	35 min	90 min	80 min	110 min	95 min
Sample input	10–100,000 cells				
Final product	RT-qPCR results		RT-qPCR results; cDNA		
Recommended for	<ul style="list-style-type: none"> <li>Gene expression analysis using TaqMan Gene Expression Assays</li> <li>Users who want faster time-to-results</li> <li>Users who do not need to archive cDNA</li> </ul>	<ul style="list-style-type: none"> <li>Gene expression analysis using primers and SYBR Green assays</li> <li>Users who want faster time-to-results</li> <li>Users who do not need to archive cDNA</li> </ul>	<ul style="list-style-type: none"> <li>Gene expression analysis using TaqMan Gene Expression Assays</li> <li>Users who want to archive cDNA</li> <li>Users who need maximum sensitivity of detection</li> </ul>	<ul style="list-style-type: none"> <li>Gene expression analysis using TaqMan Gene Expression Assays</li> <li>Users who want to archive cDNA</li> </ul>	<ul style="list-style-type: none"> <li>Gene expression analysis using primers and SYBR Green assays</li> <li>Users who want to archive cDNA</li> </ul>

\* TaqMan probe-based detection uses a fluorogenic probe specific to the target gene to detect the target as it accumulates during PCR.

\*\* SYBR Green-based detection uses SYBR Green dye (a dsDNA-binding dye) to detect PCR product as it accumulates during PCR.

## Ordering information

Product	Quantity	Cat. No.
<b>Cells-to-C<sub>T</sub> kits</b>		
Cells-to-C <sub>T</sub> 1-Step TaqMan Kit	20 preps	A25605
	100 preps	A25603
	400 preps	A25602
TaqMan Fast Advanced Cells-to-C <sub>T</sub> Kit	40 preps	A35374
	100 preps	A35377
	400 preps	A35378
TaqMan MicroRNA Cells-to-C <sub>T</sub> Kit	100 preps	4391848
TaqMan Fast Cells-to-C <sub>T</sub> Kit	100 preps	4399003
Cells-to-C <sub>T</sub> 1-Step Power SYBR Green Kit	20 preps	A25601
	100 preps	A25600
	400 preps	A25599
SYBR Green Fast Advanced Cells-to-C <sub>T</sub> Kit	40 preps	A35379
	100 preps	A35380
	400 preps	A35381
Power SYBR Green Cells-to-C <sub>T</sub> Kit	40 preps	4402953
Single Cell-to-C <sub>T</sub> qRT-PCR Kit	50 preps	4458237
	400 preps	4458236

Product	Quantity	Cat. No.
<b>Cells-to-C<sub>T</sub> kits (continued)</b>		
Cells-to-C <sub>T</sub> Stop Solution	1 mL	4402960
Cells-to-C <sub>T</sub> Bulk Lysis Reagents	2,500 preps	491851C

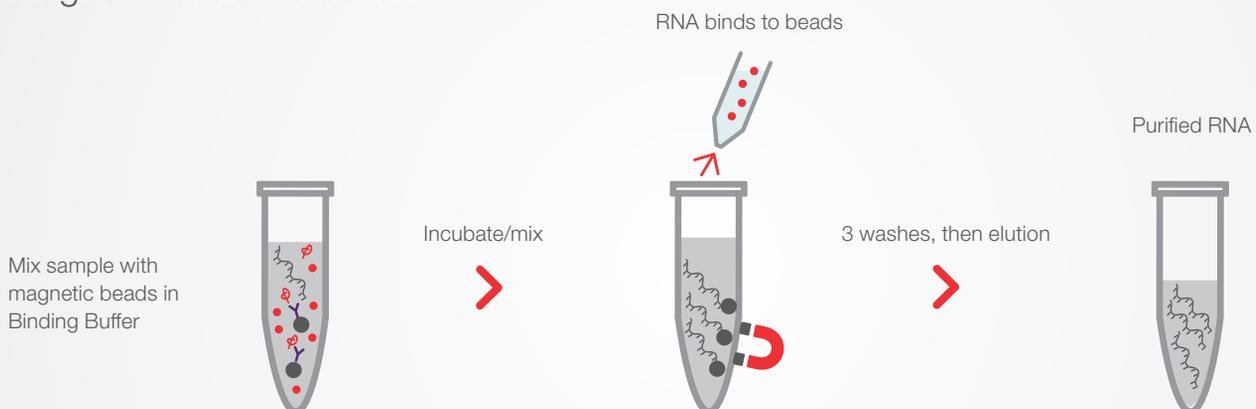
# Magnetic beads



## Make your research magnetic

Our wide range of magnetic bead platforms, which include Applied Biosystems™ MagMAX™ reagents and Invitrogen™ Dynabeads™ magnetic beads, help ensure the best balance of high yield and reproducibility with low nonspecific binding, and they can be used on Thermo Scientific™ KingFisher™ instruments for higher-throughput applications.

## Magnetic beads in action



## MagMAX magnetic beads

Walk away from centrifugation and into the future with MagMAX™ magnetic bead technology. Our uniform, mono-sized superparamagnetic beads are paired with an improved elution buffer to enable high binding efficiency and reproducibility with greater sample capture. Every MagMAX magnetic bead kit is designed to make sensitive, high-quality nucleic acid extraction simple, rapid, and automation-friendly for even the most difficult of sample types.

## MagMAX *mirVana* Total RNA Isolation Kit

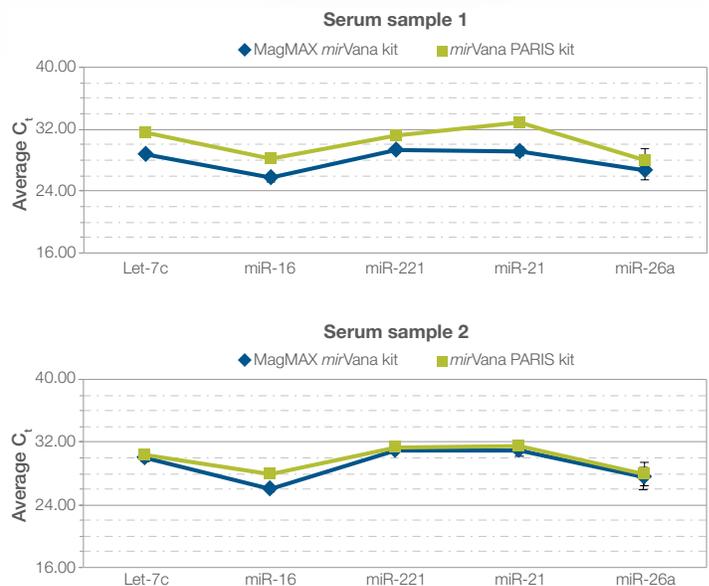
The Applied Biosystems™ MagMAX™ *mirVana*™ Total RNA Isolation Kit is a flexible magnetic bead-based format that allows RNA to be eluted in as little as 20 µL of nuclease-free water, producing more concentrated RNA. This kit can purify 6 to 96 samples at once and can be automated with Thermo Scientific™ KingFisher™ magnetic particle processors.

- Binds RNA more efficiently than silica-membrane methods
- Higher, more consistent RNA yields
- Streamlined protocols for phenol-free, scalable isolation of total RNA\*
- Recovery of pure miRNA compatible with miRNA-Seq and RT-qPCR methods such as the Applied Biosystems™ TaqMan® Advanced miRNA cDNA Synthesis Kit and other TaqMan Advanced miRNA assays

\* Full range of RNAs present in cells, from small RNAs such as miRNA, to noncoding RNA, messenger RNA, and ribosomal RNA.

### Did you know?

The MagMAX kits were originally launched in 2004 for animal health testing projects. Labs needed a process that allowed for fast, affordable RNA extraction. Scientists at Ambion, now part of Thermo Fisher Scientific, developed a method that recovered RNA from sample matrices, such as nasal swabs and ear notches, common to animal testing settings.



**Figure 11. MagMAX *mirVana* vs. Invitrogen™ *mirVana*™ PARIS™ kit.** RNA was isolated from two normal serum samples using the MagMAX *mirVana* kit and *mirVana* PARIS kit. Performance and high-throughput capabilities were compared, and levels of 5 miRNAs were measured by RT-qPCR. Greater sensitivity for each target was observed using RNA isolated with the MagMAX *mirVana* kit. The MagMAX *mirVana* kit offers superior performance and high-throughput capabilities.

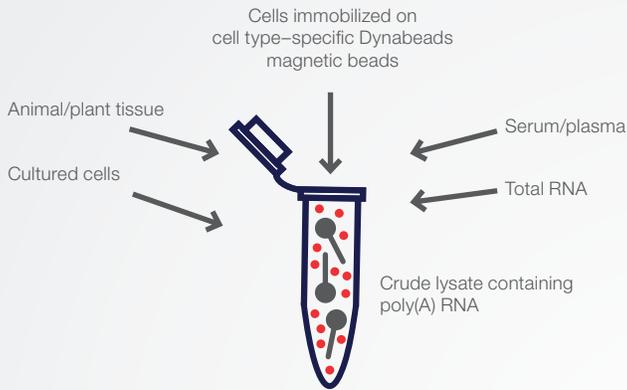
## MagMAX Plant RNA Isolation Kit

The Applied Biosystems™ MagMAX™ Plant RNA Isolation Kit is designed to isolate total RNA from a wide variety of plant species and tissue types, including any plant type and part, such as woody, polyphenol-rich, and lignified samples.

- Provides high yields of pure total RNA that can be stored long term at  $-20^{\circ}\text{C}$
- Isolates high-quality, intact total RNA, free of inhibitors and gDNA contamination
- Easily adjustable for high-throughput automation platforms and manual workflows

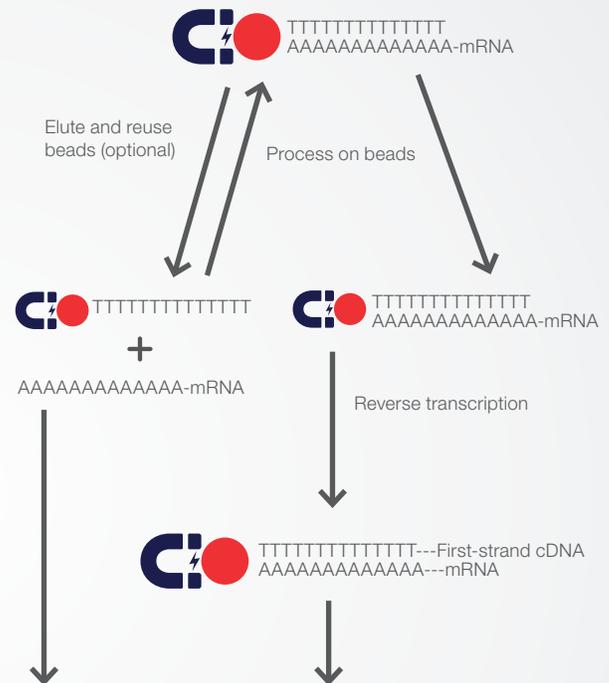


## Dynabeads magnetic beads



The Invitrogen™ Dynabeads™ mRNA DIRECT™ Kit is designed for simple and rapid isolation of pure, intact polyadenylated (poly(A)) mRNA directly from crude lysates of animal and plant cells and tissues.

- Flexible, easy protocol that can be scaled up or down to suit all sample sizes
- Can isolate mRNA from a wide variety of tissues of mammalian, fish, amphibian, insect, and plant origins
- High capture efficiency facilitates detection by RT-PCR of mRNA from highly specialized cells (e.g., isolated from a heterogeneous sample by immunomagnetic separation)



**Figure 12. Dynabeads mRNA DIRECT Kit.** This protocol includes binding of the poly(A) residues at the 3' end of most mRNA to the oligo(dT)<sub>25</sub> that is covalently coupled to the surface of the Dynabeads magnetic beads. Other RNA species lacking a poly(A) tail will not hybridize to the beads and are readily washed away. This coupling ensures the isolation of pure, intact mRNA from crude samples rich in RNase, without the use of strong chaotropic agents.

Table 5. Magnetic bead–based purification product selection guide.

Product	MagMAX <i>mirVana</i> Total RNA	Dynabeads mRNA DIRECT Purification Kit	MagMAX Viral/Pathogen Ultra Nucleic Acid Isolation Kit	MagMAX Cell-Free Total Nucleic Acid Isolation Kit	MagMAX Microbiome Ultra Nucleic Acid Isolation Kit	MagMAX FFPE DNA/RNA Ultra Kit	MagMAX Plant RNA Isolation Kit
Product size	6–96 reactions	20 preps with 5 mL 40 preps with 10 mL	100 preps	50 samples for 2 mL plasma input 25 samples for 4 mL plasma input	100 preps	96 isolations (48 RNA and 48 DNA, or 96 DNA, or 96 RNA)	384 preps
Time	1.5–2 hr	15 min	96 samples in <60 min	90 min	60 min	4 hr total time (1 hr hands-on time)	75 min
Sample input	<ul style="list-style-type: none"> <li>Blood cells</li> <li>Liquid samples (e.g., serum)</li> <li>RNA</li> <li>Tissue</li> </ul>	<ul style="list-style-type: none"> <li>Blood cells</li> <li>FFPE and other fixed samples</li> <li>Liquid samples (e.g., serum)</li> <li>Plant samples</li> <li>Tissue</li> <li>Viral samples</li> <li>Yeast</li> </ul>	<ul style="list-style-type: none"> <li>Serum</li> <li>Plasma</li> <li>Urine</li> <li>Cerebrospinal fluid (CSF)</li> <li>Universal viral transport media</li> <li>Whole blood</li> <li>Bronchoalveolar lavage (BAL)</li> <li>Swabs</li> <li>Toenail fungus</li> </ul>	<ul style="list-style-type: none"> <li>Serum</li> <li>Plasma</li> <li>Urine</li> </ul>	<ul style="list-style-type: none"> <li>Stool</li> <li>Soil</li> <li>Swabs</li> </ul>	<ul style="list-style-type: none"> <li>FFPE tissue samples, such as resections, biopsies, and aspirates</li> </ul>	<ul style="list-style-type: none"> <li>Any plant sample</li> </ul>
Final product	Total RNA*	mRNA	RNA and DNA	cfRNA and cfDNA	RNA and DNA	RNA and DNA	Total RNA
Recommended for	<ul style="list-style-type: none"> <li>NGS</li> <li>qPCR</li> <li>miRNA analysis</li> </ul>	<ul style="list-style-type: none"> <li>Cloning</li> <li>Northern blotting</li> <li>Nuclease protection assays</li> <li>qPCR, RT-PCR</li> <li>cDNA library construction</li> </ul>	<ul style="list-style-type: none"> <li>NGS</li> <li>Real-time PCR</li> </ul>	<ul style="list-style-type: none"> <li>NGS</li> <li>qPCR</li> </ul>	<ul style="list-style-type: none"> <li>Microarrays</li> <li>qPCR</li> <li>NGS</li> </ul>	<ul style="list-style-type: none"> <li>NGS</li> <li>PCR, RT-PCR (endpoint)</li> <li>qPCR</li> <li>miRNA analysis</li> </ul>	<ul style="list-style-type: none"> <li>RT-PCR (endpoint)</li> <li>qPCR</li> <li>Sequencing</li> <li>Northern blotting</li> <li>Nuclease protection assays</li> </ul>

\*Including miRNA.

## Ordering information

Product	Quantity	Cat. No.
MagMAX Cell-Free Total Nucleic Acid Isolation Kit	1 kit	A36716
MagMAX FFPE DNA/RNA Ultra Kit	1 kit	A31881
MagMAX Microbiome Ultra Nucleic Acid Isolation Kit, with bead plate	100 preps	A42357
MagMAX Microbiome Ultra Nucleic Acid Isolation Kit, with bead tubes	100 preps	A42358
MagMAX <i>mirVana</i> Total RNA Isolation Kit	96 preps	A27828
MagMAX Plant RNA Isolation Kit	96 preps	A33784
	384 preps	A33899
MagMAX for Stabilized Blood Tubes RNA Isolation Kit (Tempus RNA tubes)	96 preps	4451893
MagMAX for Stabilized Blood Tubes RNA Isolation Kit (PAXgene RNA tubes)	96 preps	4451894
MagMAX Viral/Pathogen Nucleic Acid Isolation Kit*	100 preps	A42352
MagMAX Viral/Pathogen Ultra Nucleic Acid Isolation Kit*	100 preps	A42356
Dynabeads mRNA DIRECT Purification Kit	5 mL	61011
	10 mL	61012

\* Bulk reagents available for purchase separately.

Find out more at [thermofisher.com/magmax](https://thermofisher.com/magmax)

### Don't forget to deplete ribosomal RNA

Invitrogen™ RiboMinus™ technology is designed to enrich the whole spectrum of RNA transcripts by selectively depleting ribosomal RNA (rRNA), regardless of their polyadenylation status or the presence of a 5' cap structure. The RiboMinus method has been shown to remove the vast majority of the most abundant rRNA molecules (up to 99.9%) to allow for greater interrogation of less abundant transcripts.

### Ribosomal RNA depletion kit

Invitrogen™ RiboMinus™ Bacteria 2.0 Transcriptome Isolation Kit was developed specifically for the study of the microbiome and is great for a wide range of sample types. This kit was designed to enable efficient transcriptome enrichment by depleting large rRNA from total bacterial RNA.

- Comprehensive rRNA removal
- Increased representation of species-level RNA transcripts
- Ability to remove rRNA from gram-negative and gram-positive bacteria
- Magnetic bead technology compatible with KingFisher instruments

Table 6. Ribosomal RNA depletion product selection guide.

Product	RiboMinus Bacteria 2.0 Transcriptome Isolation Kit	RiboMinus Eukaryote System v2	RiboMinus Plant Kit for RNA-Seq
Product size	12 preps	12 preps	8 preps
Sample input	100 ng–5 µg total RNA	1–5 µg total RNA	2–10 µg total plant RNA
Final product	Transcriptome RNA		
Recommended for	<ul style="list-style-type: none"> <li>• NGS</li> <li>• Northern blotting</li> <li>• qPCR</li> <li>• RT-PCR</li> <li>• Sequencing</li> <li>• cDNA library construction</li> </ul>		

### Ordering information

Product	Quantity	Cat. No.
RiboMinus Transcriptome Isolation Kit, Bacteria	12 preps	K155004
RiboMinus Human/Mouse Transcriptome Isolation Kit	6 preps	K155001
RiboMinus Transcriptome Isolation Kit, Human/Mouse	6 preps	K155002
RiboMinus Transcriptome Isolation Kit, Yeast	12 reactions	K155003
RiboMinus Eukaryote System v2	12 preps	A15026
RiboMinus Plant Kit for RNA-Seq	8 preps	1083808

Use your mobile phone's camera app to scan the QR codes below. Gain immediate access to our Dynabeads magnetic beads brochure and online selection guide for a comprehensive guide to Dynabeads technology and products.

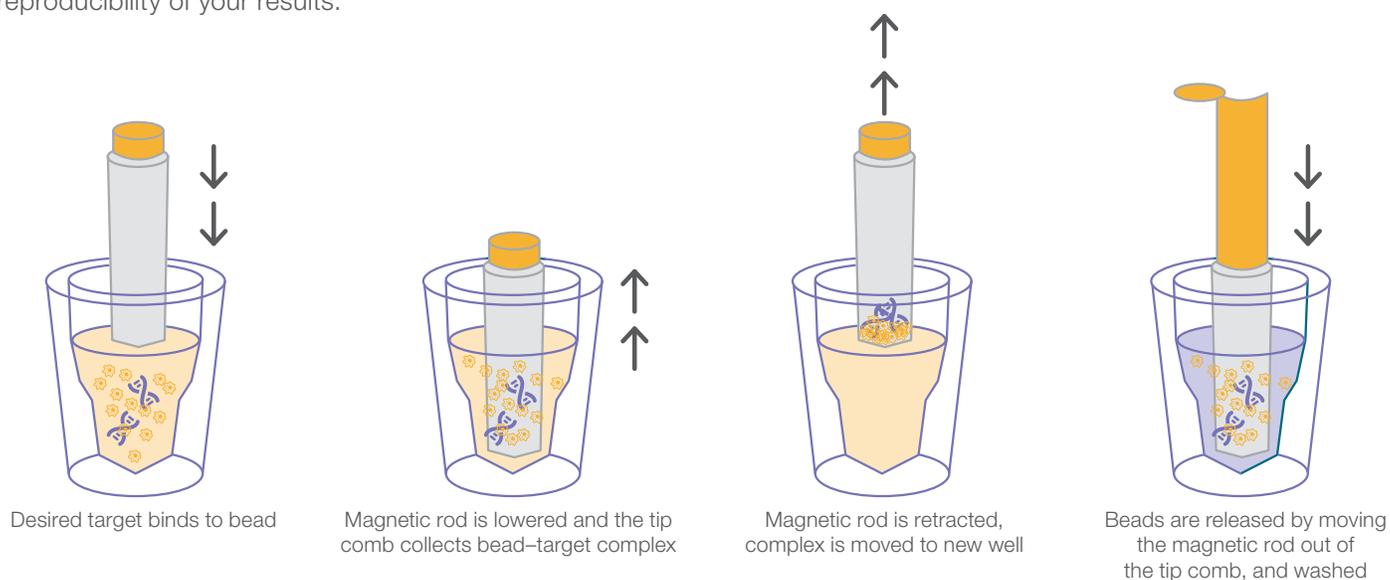


# Instruments

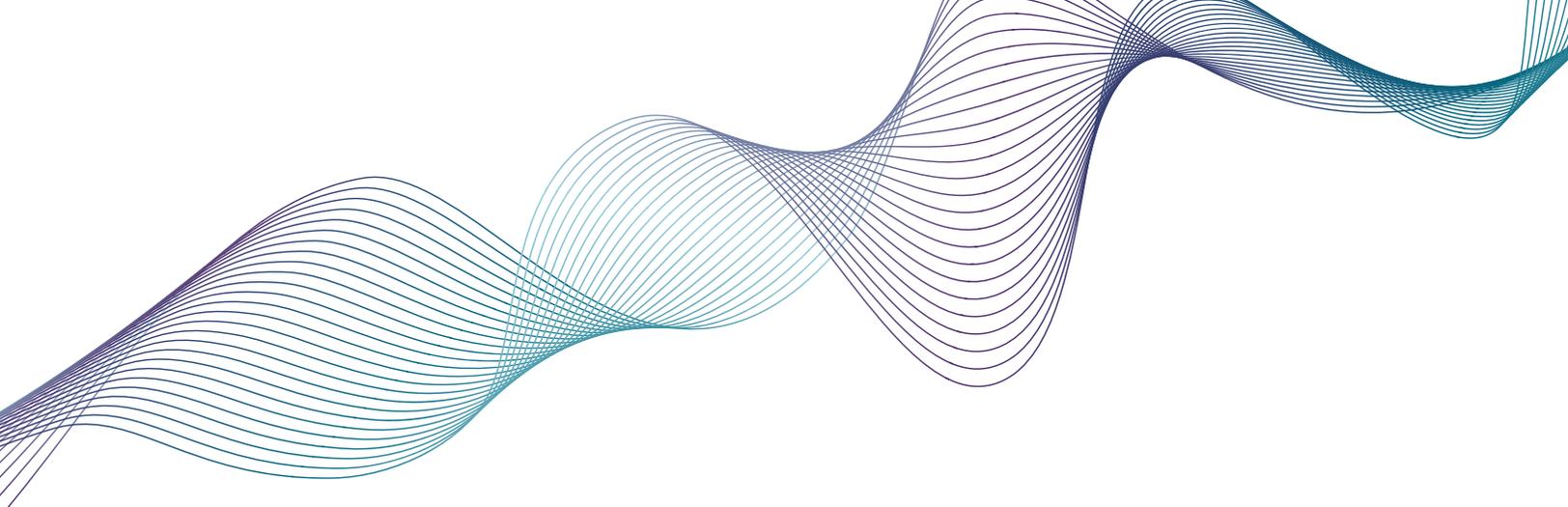


Pair any of the MagMAX purification kits with the KingFisher instruments to automate your RNA extractions. The KingFisher instruments provide easy-to-follow, optimized protocols for RNA isolation from most sample types for nearly every downstream application. Save valuable time by removing manual steps and reducing overall processing time, while minimizing user error and increasing reproducibility of your results.

The KingFisher instruments automate extraction of DNA, RNA, protein, and cells by moving magnetic beads (not liquids), leading to clean extractions and enabling consistent results. Using a simple 4-step process—lyse, bind, wash, and elute—the KingFisher instruments can automate the extraction of any analyte of interest with a bead on it.



**Figure 13. How KingFisher instruments work.** Magnetic beads mix with sample and bind to desired target. The instruments magnetic rod lowers into the homogenate and attracts the magnetic beads bound to desired target at the bottom of the tip comb. Magnetic rod retracts and moves the beads bound to desired target to a new set of wells. The tip comb mixes reagents with the beads, as the magnetic head moves up and down. This process is repeated until desired target is completely purified and unbound from magnetic beads.



**Table 7. KingFisher instrument comparison.**

KingFisher instrument:	Duo Prime	Flex	Presto
<b>Instrument size</b>	Compact benchtop	Benchtop	Benchtop—integrates with robotic liquid handler
<b>Throughput level</b>	Low to medium	Medium to high	Ultrahigh
<b>Processing volume range</b>	<ul style="list-style-type: none"> <li>• 50–1,000 <math>\mu\text{L}</math>: 12-pin magnet head</li> <li>• 200–5,000 <math>\mu\text{L}</math>: 6-pin magnet head</li> </ul>	<ul style="list-style-type: none"> <li>• 20–100 <math>\mu\text{L}</math>: 96-well PCR plate, skirted</li> <li>• 20–200 <math>\mu\text{L}</math>: 96-well plate</li> <li>• 50–1,000 <math>\mu\text{L}</math>: 96 deep-well plate</li> <li>• 200–5,000 <math>\mu\text{L}</math>: 24 deep-well plate</li> </ul>	<ul style="list-style-type: none"> <li>• 50–1,000 <math>\mu\text{L}</math>: 96 deep-well plate</li> <li>• 200–5,000 <math>\mu\text{L}</math>: 24 deep-well plate</li> <li>• 50–150 <math>\mu\text{L}</math>: 96-well KingFisher standard plate</li> </ul>
<b>Samples per run</b>	6 or 12	24 or 96	24 or 96
<b>Customizable protocols</b>	Yes, with PC software	Yes, with PC software	Yes, with PC software
<b>Heating/cooling</b>	<ul style="list-style-type: none"> <li>• 10°C to 75°C (plate row block A)</li> <li>• 4°C to 75°C (elution strip block)</li> </ul>	<ul style="list-style-type: none"> <li>• From 5°C above ambient temperature to 115°C</li> </ul>	<ul style="list-style-type: none"> <li>• From 5°C above ambient temperature to 115°C</li> </ul>
<b>Ultraviolet lamp</b>	8 watts (up to 16 hr)	No	No

Use your mobile phone’s camera app to scan the QR codes below.  
Gain immediate access to:

KingFisher product brochure for more information on our KingFisher instruments and reagents



How much intact RNA did you purify? There are two ways to find out

### Qubit Flex Fluorometer

The Invitrogen™ Qubit™ Flex Fluorometer is a benchtop fluorometer designed for highly accurate quantification of DNA, RNA, miRNA, and protein. With the Qubit Flex Fluorometer, you have the flexibility to directly measure fluorescence of up to 8 samples simultaneously, which reduces assay variability. Paired with Qubit reagents, the Qubit Flex Fluorometer is part of an optimized workflow that generates highly accurate and reproducible results.

- Measures up to 8 samples and quantifies DNA, RNA, and protein up to 50% faster than single-sample readers
- Works seamlessly with Qubit reagents to generate reliable, sensitive, and specific results
- Highly accurate measurements using only 1–20  $\mu\text{L}$  of sample, even with very dilute samples
- Quickly generates Qubit working solution preparation instructions and determines the molarity of your samples



**Reagent Calculator**

How many samples?

How many standards?   
(0, 2 or 3 standards)

Include overage  
(3 extra tubes)

Results:

Add 34 $\mu\text{L}$  dye to 6766 $\mu\text{L}$  buffer for a total volume of 6800 $\mu\text{L}$

**Done**

**Assay Range Calculator**

Enter sample volume used:  
1X dsDNA HS

Range	Sample Concentration (ng/ $\mu\text{L}$ )
Extended low	0.01 - < 0.02
Core	0.02 - 10
Extended high	> 10 - 12

**Done**

**Molarity Calculator**

Desired units:  to

Molecular weight:  g/mol

Auto-populate DNA length

Sample	Concentration (ng/ $\mu\text{L}$ )	Length (bp)	Molarity (nM)
S1	4.93	<input type="text" value="500"/>	14.9
S2	4.89	<input type="text" value="500"/>	14.8
S3	4.89	<input type="text" value="500"/>	14.8
S4	4.87	<input type="text" value="500"/>	14.8

**Export** **Cancel** **Calculate**

**Normalization Calculator**

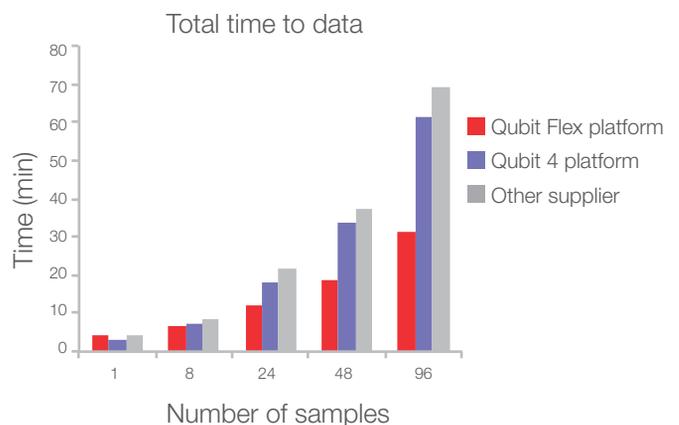
Final Concentration: 2 ng/ $\mu\text{L}$  Final Volume: 10  $\mu\text{L}$

Sample	Add sample ( $\mu\text{L}$ )	Add buffer ( $\mu\text{L}$ )
S1	2.3	7.7
S2	2.2	7.8
S3	2.3	7.7
S4	2.2	7.8
S5	2.2	7.8
S6	2.3	7.7
S7	2.2	7.8
S8	2.3	7.7

Page 1 of 3

**Export** **Done**

- Use the **reagent calculator** to determine the amount of working solution needed based on sample quantity.
- The **assay range calculator** displays the core sample concentration range for which the selected assay is most accurate, as well as the extended low and high ranges, based on the sample volume. This range estimate can help determine which Qubit assay provides the most accurate measurement.
- The **molarity calculator** can quickly calculate the molarity of your samples based on nucleic acid length and concentration.
- The **normalization calculator** replaces spreadsheet calculations and can easily normalize to a desired mass, concentration, or molarity.

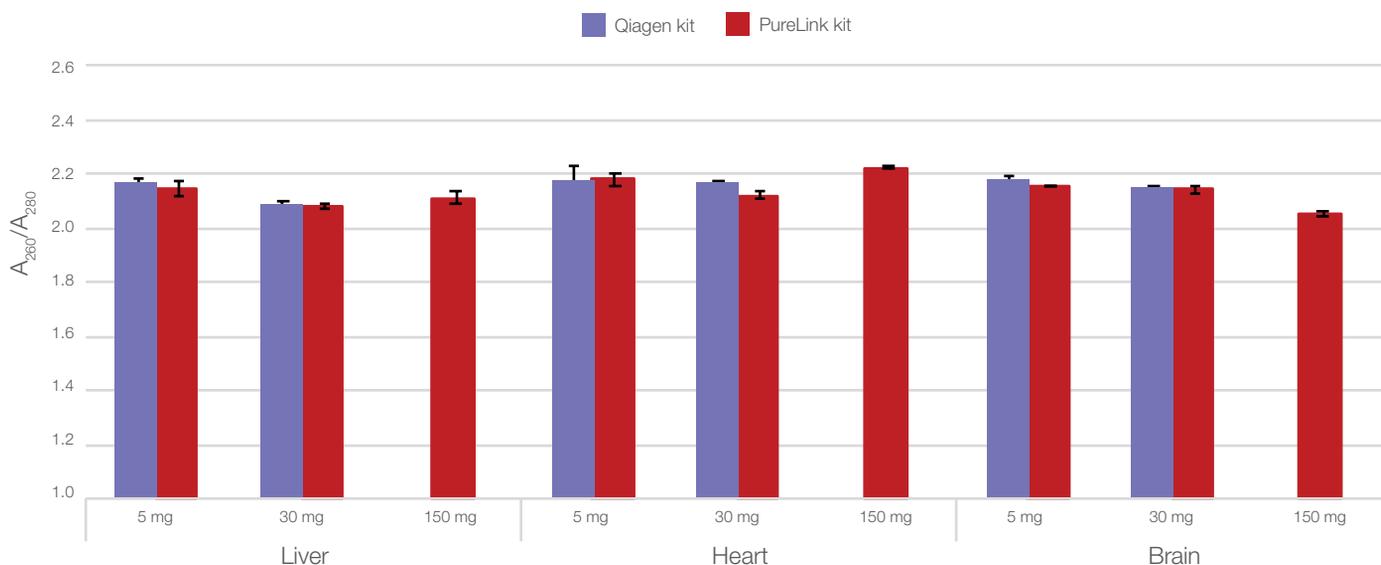


**Figure 14. Time savings with the Qubit Flex Fluorometer.** Time trial on 1 to 96 samples shows up to 50% time savings with the Qubit Flex Fluorometer. Time savings began with 8 samples, with more time saved when measuring even more samples.

## NanoDrop One Spectrophotometers

Check the quantity and quality of DNA, RNA, and protein with only 1–2  $\mu\text{L}$  of sample in seconds with no dilutions using the Thermo Scientific™ NanoDrop™ One and One<sup>c</sup> Microvolume UV-Vis Spectrophotometers. Gain a more complete understanding of sample quality before using samples in downstream applications, with Thermo Scientific™ Acclaro™ sample intelligence technology built into every NanoDrop One instrument.

- Achieve accurate results with full spectral data
- Identify sample contaminants (phenol, guanidinium salts, and protein) with sophisticated Acclaro algorithms and report corrected concentrations
- Easily transfer data to PC or network via Wi-Fi, Ethernet, or USB storage device
- Print results from on-board control
- Access data anywhere, anytime with Connect, our cloud-enabled platform



**Figure 15. Purity analysis of RNA.** The purity of RNA from three different tissue types was assessed using the NanoDrop spectrophotometer. All RNA samples had  $A_{260}/A_{280}$  ratios between 2.1 and 2.2, indicating high RNA purity.

## Ordering information

Product	Cat. No.
NanoDrop One Microvolume UV-Vis Spectrophotometer with Wi-Fi	ND-ONE-W
NanoDrop One <sup>c</sup> Microvolume UV-Vis Spectrophotometer with Wi-Fi	ND-ONEC-W
Qubit Flex Fluorometer	Q33327
Qubit Flex System Verification Assay Kit	Q33254
Qubit Flex Assay Reservoirs	Q33253
Qubit Flex Assay Tube Strips	Q33252

# Tips and tricks for specialty samples



## Sample types

The biological nature of your sample type will affect the methods you choose for purifying the most RNA from your sample.

## What is the best purification method for your sample type and application?



### Mammalian cells

Mammalian cells have membranes that are easily broken down. Cultured cells that are typically homogeneous can be purified by a variety of different methods. For some applications such as RT-qPCR, crude lysates may be adequate. For NGS, a higher level of purity is desired for better results.



### Brain and kidney tissue

Based on their composition, tissue samples may require stronger reagents to break them down. Brain and kidney tissues are high in fat. TRIzol Reagent is especially effective in breaking them down. Combine TRIzol Reagent with Phasemaker Tubes and PureLink columns to maximize your yield and purity.



### Blood cells

Blood cells are heterogeneous and may contain molecules that impact downstream reactions. Specialty kits that isolate RNA from blood are recommended for sensitive applications such as NGS. For other applications, PureLink Mini Kits are a good choice.



### Bacteria, yeast, and plants

Bacteria, yeast, and plants have different kinds of cell walls and may require different reagents to get complete extraction. Specialty kits are available for these purposes.

**Table 7. Specialty kits for RNA purification.** Choose your perfect kit based on sample type and throughput. The most recommended kits for the broadest applications are listed.

Sample type	Special stabilization	1–24 samples	>25 samples
Cultured cells		<ul style="list-style-type: none"> <li>PureLink RNA Mini Kit (cat. no. 12183018A), p 12</li> <li>TRIzol Reagent (cat. no. 15596026), p 7</li> </ul>	<ul style="list-style-type: none"> <li>Cells-to-C<sub>T</sub> kits (for RT-qPCR applications), p 21</li> <li>PureLink Pro 96 Total RNA Purification Kit (cat. no. 12173011A), p 16</li> </ul>
Blood		<ul style="list-style-type: none"> <li>PureLink RNA Mini Kit (cat. no. 12183018A), p 12</li> <li>TRIzol LS Reagent (cat. no. 10296010), p 9</li> </ul>	<ul style="list-style-type: none"> <li>MagMAX mirVana Total RNA Isolation Kit (cat. no. A27828), p 23</li> <li>Dynabeads mRNA DIRECT Kit (cat. no. 61011), p 24</li> </ul>
Fresh or frozen brain and kidney tissue	RNA <sub>later</sub> Solution	<ul style="list-style-type: none"> <li>TRIzol Plus RNA Purification Kit (cat. no. 12183555) and Phasemaker Tubes Complete System (cat. no. A33248), p 10</li> <li>PureLink RNA Mini Kit (cat. no. 12183018A), p 12</li> </ul>	<ul style="list-style-type: none"> <li>MagMAX mirVana Total RNA Isolation Kit (cat. no. A27828), p 23</li> </ul>
Fresh or frozen other animal tissues	RNA <sub>later</sub> Solution	<ul style="list-style-type: none"> <li>PureLink RNA Mini Kit (cat. no. 12183018A), p 12</li> <li>TRIzol Plus RNA Purification Kit (cat. no. 12183555) and Phasemaker Tubes (cat. no. A33248) Complete System, p 10</li> </ul>	<ul style="list-style-type: none"> <li>MagMAX mirVana Total RNA Isolation Kit (cat. no. A27828), p 23</li> </ul>
FFPE samples		<ul style="list-style-type: none"> <li>RecoverAll Total Nucleic Acid Isolation Kit for FFPE (cat. no. AM1975), p 14</li> </ul>	<ul style="list-style-type: none"> <li>MagMAX FFPE DNA/RNA Ultra Kit (cat. no. A31881), p 25</li> </ul>
Plant		<ul style="list-style-type: none"> <li>PureLink RNA Mini Kit (cat. no. 12183018A), p 12</li> <li>PureLink Plant RNA Reagent (cat. no. 12322012)</li> </ul>	<ul style="list-style-type: none"> <li>MagMAX Plant Isolation Kit (cat. no. A33784), p 24</li> </ul>
Yeast		<ul style="list-style-type: none"> <li>PureLink RNA Mini Kit (cat. no. 12183018A), p 12</li> </ul>	<ul style="list-style-type: none"> <li>Dynabeads mRNA DIRECT Purification Kit (cat. no. 61011), p 24</li> <li>MagMAX Viral/Pathogen Ultra Nucleic Acid Isolation Kit (cat. no. A42356), p 25</li> </ul>
Bacteria		<ul style="list-style-type: none"> <li>PureLink RNA Mini Kit (cat. no. 12183018A), p 12</li> <li>TRIzol Max Bacterial RNA Isolation Kit and Max Bacterial Enhancement Reagent (cat. no. 16096020), p 9</li> </ul>	<ul style="list-style-type: none"> <li>MagMAX Total Nucleic Acid Isolation Kit (cat. no. AM1840)</li> </ul>
Virus		<ul style="list-style-type: none"> <li>PureLink Viral RNA/DNA Mini Kit (cat. no. 12280050), p 16</li> <li>RNAqueous Total RNA Isolation Kit (cat. no. AM1912), p 16</li> </ul>	<ul style="list-style-type: none"> <li>MagMAX Viral/Pathogen Ultra Nucleic Acid Isolation Kit (cat. no. A42356), p 25</li> </ul>

# Sample prep essentials

RNA is sensitive to degradation by RNases. Stock your lab with these essentials—the key products to avoid, detect, and inhibit RNases—and protect your sample prep. See below for tips and tricks as well as product features.

## Invitrogen™ RNA/later™ Solution for RNA storage and stabilization

- Use this convenient room temperature–stable solution to store RNA at the bench, in the field, or at different time points, without the need for liquid nitrogen
- Use thin tissue samples (0.5 cm) to ensure that RNA/later solution can quickly permeate before RNases destroy the RNA
- When you're ready to isolate, remove tissue from solution and suspend sample as if it has just been harvested

## Invitrogen™ Nuclease-Free Water

- Purified water can have minerals and high pH; ensure consistency when preparing reagents and resuspending RNA
- Thoroughly rinse lab surfaces to reduce inhibitory residues and contaminants



- Aqueous, nontoxic tissue storage reagent
- Eliminates RNases and rapidly permeates tissue to stabilize and protect cellular RNA
- Endonuclease-, exonuclease-, DNase-, and RNase-free water
- Filtered, autoclaved, and rigorously tested according to ISO 9001 specifications
- DEPC-treated and non-DEPC-treated options available

### RNaseZap solution for surface decontamination

- Store this room temperature–stable solution on your bench for quick and easy use
- RNaseZap wipes to decontaminate pipettes and hard-to-reach surfaces
- Typical detergents often spread RNase contamination, so use RNaseZap solution to help ensure that labware, instruments, and surfaces are RNase-free

### Invitrogen RNase-free tubes

- Available in PCR, microcentrifuge, and conical tube formats

### SUPERase•In RNase Inhibitor for RNA inhibition

- Effective at pH 5.5–8.5 and active at up to 65°C
- Removes high concentrations of dried-on RNase A
- Add to solutions to reduce and prevent RNase contamination



- Maintains reaction yields, prevents degradation, and reduces variable results
- Invitrogen™ RNase AWAY™ Decontamination Reagent (Cat. No. 10328011) also available
- Autoclave-safe, nuclease-free tubes have undergone rigorous testing
- Suitable for molecular biology techniques
- Inhibits and controls for RNases A, B, C, 1, and T1, which can co-purify with isolated RNA
- Doesn't interfere with other enzymes like RNA polymerases, reverse transcriptases, or *Taq* DNA polymerase

Find out more at [thermofisher.com/essentials](https://thermofisher.com/essentials)

## Ordering information

Product	Quantity	Cat. No.
<b>RNA lab essentials</b>		
RNase-Free Tips (200 µL)	10 racks	AM12650
RNase-Free Tips (1,000 µL)	10 racks	AM12660
Barrier (Filter) Tips (10 µL) (compatible with Eppendorf pipettors)	10 racks	AM12635
Barrier (Filter) Tips (20 µL)	10 racks	AM12645
Barrier (Filter) Tips (100 µL)	10 racks	AM12648
Barrier (Filter) Tips (200 µL)	10 racks	AM12655
Barrier (Filter) Tips (1,000 µL)	10 racks	AM12665
Thin-walled, frosted lid, RNase-Free PCR Tubes (0.2 mL)	1,000 tubes	AM12225
PCR Tubes and Caps, RNase-Free (0.2 mL, 8-strip format)	125 strips	AM12230
Thin-walled, dome cap, RNase-Free PCR Tubes (0.5 mL)	1,000 tubes	AM12250
Thin-walled, frosted lid, RNase-Free PCR tubes (0.5 mL)	1,000 tubes	AM12275
RNase-Free Microfuge Tubes (0.5 mL)	1,000 tubes	AM12300
Nonstick, RNase-Free Microfuge Tubes (0.5 mL)	500 tubes	AM12350
RNase-Free Microfuge Tubes (1.5 mL)	500 tubes	AM12400
RNase-Free Microfuge Tubes (2.0 mL)	500 tubes	AM12425
Conical Tubes (15 mL) (racked)	500 tubes	AM12500
Conical Tubes (50 mL) (racked)	200 tubes	AM12501
DEPC-Treated Water	10 x 50 mL	AM9906
	1 x 100 mL	AM9915G
	5 x 100 mL	AM9916
	1 x 500 mL	AM9920
	1 x 1,000 mL	AM9922
	4 x 1,000 mL	4387937

Product	Quantity	Cat. No.
<b>RNA lab essentials (continued)</b>		
Nuclease-Free Water (not DEPC-treated)	10 x 50 mL	AM9937
	1 x 100 mL	AM9938
	5 x 100 mL	AM9939
	1 x 500 mL	AM9930
	1 x 1,000 mL	AM9932
	4 x 1,000 mL	4387936
RT-PCR Grade Water	10 x 1.5 mL	AM9935
UltraPure DNase/RNase-Free Distilled Water	500 mL	0977015
	10 x 500 mL	0977023
RNaseZap RNase Decontamination Solution	250 mL	AM9780
	6 x 250 mL	AM9782
	4 L	AM9784
RNaseZap RNase Decontamination Wipes	100 sheets	AM9786
RNaseZap RNase Decontamination Wipes Refill	300 sheets	AM9788
ElectroZap Electrode Decontamination Solution	250 mL	AM9785
RNase AWAY Decontamination Reagent	250 mL	0328011
RNAlater Stabilization Solution	50 x 1.5 mL	AM7022
	20 x 5 mL	AM7023
	1 x 100 mL	AM7020
	1 x 250 mL	AM7024
	1 x 500 mL	AM7021
RNAlater-ICE Frozen Tissue Transition Solution	25 mL	AM7030
	10 x 25 mL	4427575
THE RNA Storage Solution	10 x 1 mL	AM7000
	50 mL	AM7001
Tempus Blood RNA Tube	50 tubes	4342792
LeukoLOCK Total RNA Isolation System	20 preps	AM1923



# Services and support

Providing fast responses by experienced scientists

More than 1,300 service and support specialists worldwide partner with you to help enable your scientific success through:



**Service plans**—planned maintenance and guaranteed response times to help you avoid unnecessary downtime, reduce strain on laboratory staff, and extend the life of your instruments



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Find out more about our services and support at  
[thermofisher.com/instrumentservices](https://www.thermofisher.com/instrumentservices)

# RNA technical resources

Collection, protection, isolation, and gene expression

Consider us to be your essential resource for all your nucleic acid purification and analysis support needs. Navigate through the DNA and RNA support categories below to obtain relevant technical information, view tips and tricks when starting an experiment, and find answers to everyday problems.



## Support

- [thermofisher.com/napsupport](https://thermofisher.com/napsupport)
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## Web resources

- [thermofisher.com/contactus](https://thermofisher.com/contactus)
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