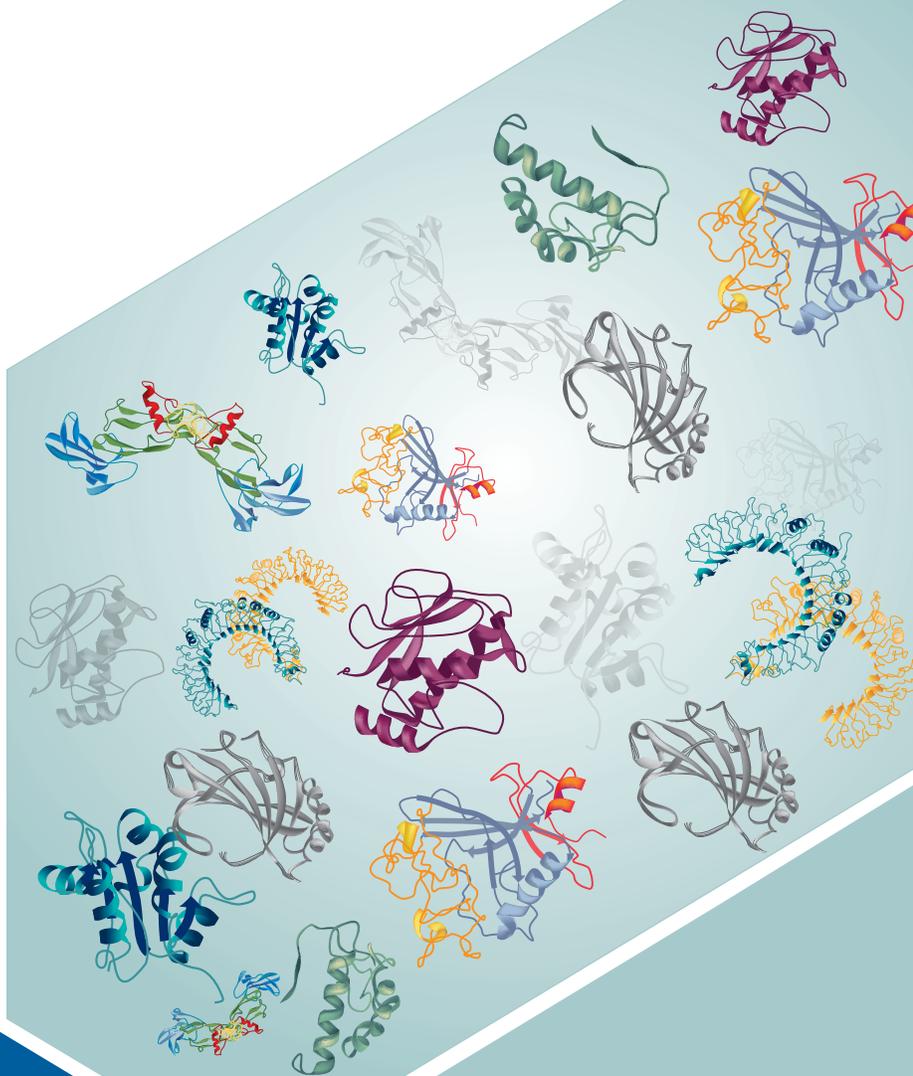


Recombinant Proteins



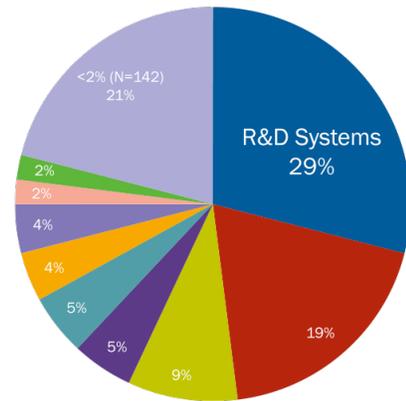
Setting the Standard in Proteins for Over 30 Years

All of our proteins are produced by scientists – for scientists, so we understand that producing recombinant proteins is about generating the reliable tools that researchers need to thrive.

We manufacture more than 95% of our proteins. It gives us complete control over all aspects of production, so nothing becomes an R&D Systems protein that does not meet our industry-leading specifications.

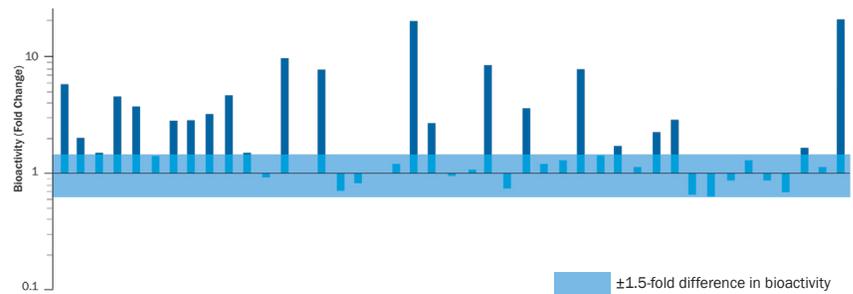
Trusted by Research

In a survey of 1,125 manuscripts published in 2013 covering cancer, immunology, neuroscience, and stem cell research, 29% cited the use of R&D Systems proteins, greater than any other single protein manufacturer.



Leading the Way in Bioscience

R&D Systems recombinant proteins were compared with those from other manufacturers in side by side bioassays. Over half of the 43 tested R&D Systems proteins exhibited 1.5-fold or higher bioactivity, compared to competitor proteins.



First Class Products & Services

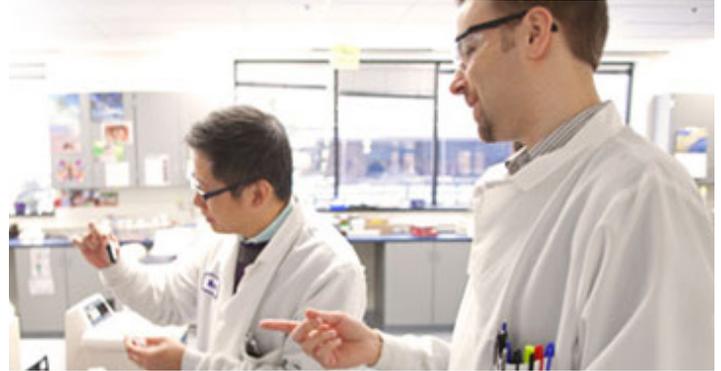
We understand the experimental outcomes can be limited by the performance of your protein. That is why the focus on quality starts at the birth of each R&D Systems protein.

During product development our optimization process involves analysis of protein sequence, expression system, and formulation to ensure we provide proteins with the best possible bio-activity and performance.

We are proud that R&D Systems experience and dedication to protein development and manufacturing is unmatched in the life science industry.

Our quality commitment does not stop with our products. Wherever you are in the world, you can access our highly trained technical service staff and the scientists responsible for protein development, so we can answer any questions you might have.

Let us be your trusted partner in research.



Learn more | rndsistemas.com/quality

The Four Pillars of R&D Systems Quality

To guarantee you the best possible proteins, we focus on the following quality pillars.



Bioactivity

Biological activity assays, based on the available scientific literature, are developed for each protein we produce. Each new lot has to pass our strict QC activity parameters before it is released for sale.



Purity

Be confident that the results obtained in your experiments are not due to contaminants. The majority of our proteins have >95% purity and have a guaranteed industry-leading endotoxin level of ≤ 0.1 EU/ μ g (established by LAL assay).



Stability

We constantly monitor the condition of our proteins to check for long term performance. Our proteins are shipped lyophilized or in specially optimized formulations, so each recombinant protein reaches you in perfect condition.



Consistency

You can be sure of the reliability of our proteins because of our rigorous QC and production standards. Each new lot is compared to the previous for bioactivity, purity and endotoxin level.

With you in your Research . . . at Every Step

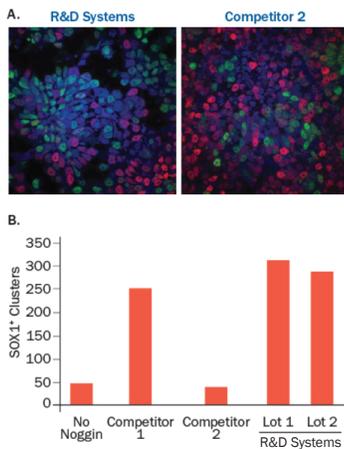
What is important to you in a recombinant protein? Is it the species, the activity, available size, expression system or documentation?

Every research question is unique and so requires a unique solution. That is why the range of R&D Systems recombinant proteins give you the choices to tailor the right protein solution to your research.

By listening to the scientists we serve, R&D Systems produces the protein tools that are the most useful to you.

From immunology to apoptosis, neuroscience to cancer research – our protein catalogue spans the widest range of research areas. This ensures that R&D Systems is your partner for all recombinant protein needs - whatever your research goals.

Stem Cells



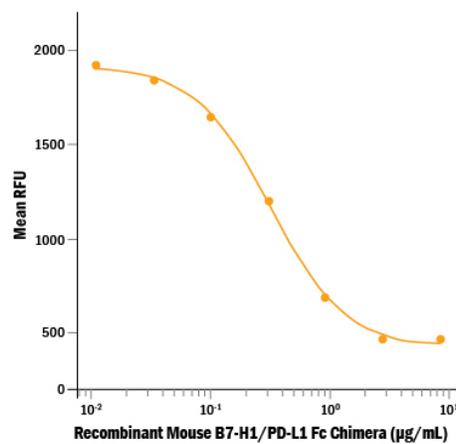
Recombinant Human Noggin

Catalog # 6057-NG

Noggin is a highly conserved vertebrate signaling molecule important in embryonic nerve, muscle and bone tissue development.

A. Epithelial stem cells treated with Recombinant Human Noggin (catalog # 6057-NG) show greater ectoderm differentiation compared to competitor recombinant human Noggin. B. The average number of SOX1-positive clusters revealed that 2 lots of R&D Systems' Noggin consistently showed greater ectoderm differentiation compared to that of 2 competitor's.

Immunology



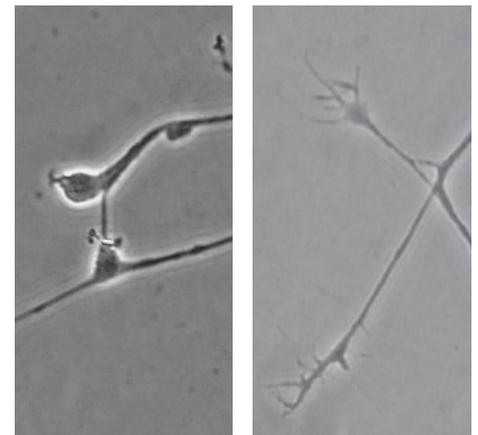
Recombinant Mouse B7 H1/PD-L1

Catalog # 1019-B7

B7 H1/PD-L1 plays a role in the development of immune tolerance by promoting T cell anergy and enhancing regulatory T cell development.

Recombinant Mouse B7-H1/PD-L1 Fc Chimera (catalog # 1019-B7) inhibits anti-CD3-induced cell proliferation of stimulated mouse T cells. The ED_{50} for this effect is typically 0.15-0.75 $\mu\text{g/mL}$.

Neuroscience



Recombinant Human Semaphorin 3A

Catalog # 1250-S3

The semaphorins are secreted and membrane signaling molecules and have roles in axon guidance during neuronal development.

Treatment with Semaphorin 3A-Induces Growth Cone Collapse. A fully extended chick dorsal root ganglion growth cone grown in the presence of Recombinant Human β -NGF (Catalog #256-GF) was untreated (A) or treated (B) with Recombinant Human Semaphorin 3A (Catalog # 1250-S3).

The Format You Need – When Your Research Needs It

As research projects evolve – from basic research to pre-clinical applications, the requirements for your reagents also evolve. The availability of key reagents in the format you need can influence the pace of your discovery.

Research Grade

Where available, our recombinant proteins are available with and without protein carrier, giving you flexibility in format. We use a range of expression systems – from bacterial to mammalian cell lines, to ensure the highest quality biological activity.

Animal – Free Manufacturing Conditions

We also offer proteins manufactured and purified exclusively under animal-free conditions. The proteins generated under animal-free conditions share the same biological activities as those produced using our standard research grade, easing the process of transition between protein formats.

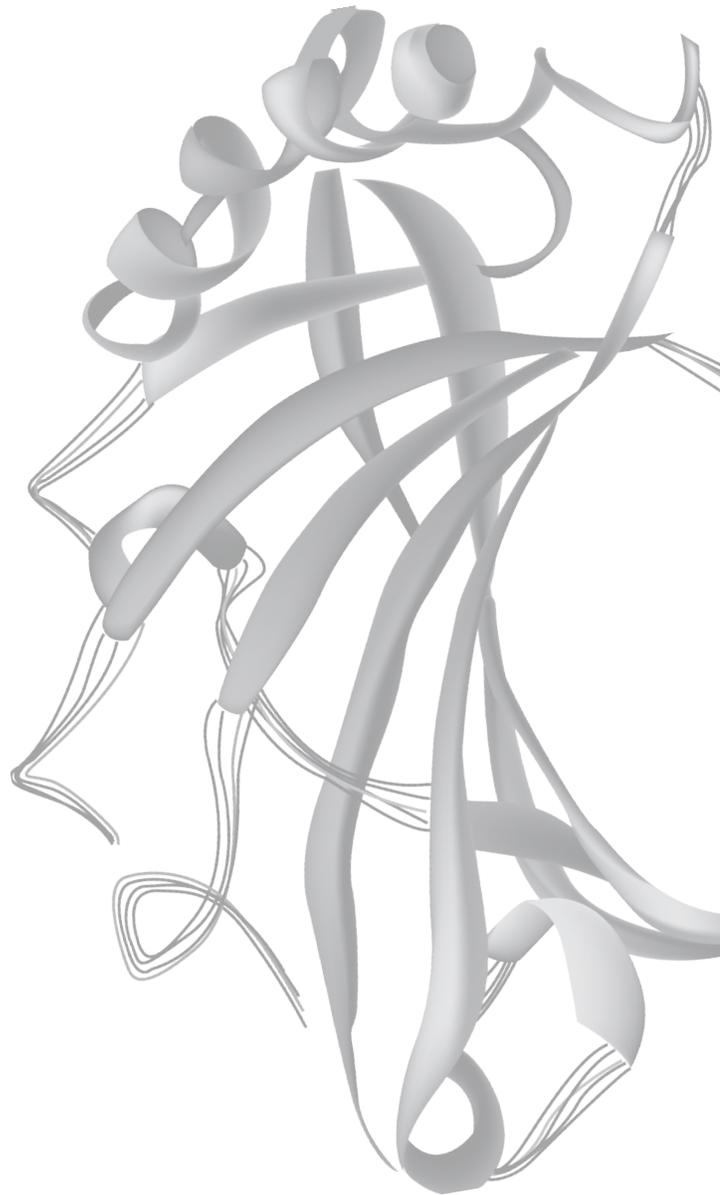
Good Manufacturing Practices (GMP) – Grade

For further research uses and manufacturing applications, you can use top quality R&D Systems produced to GMP standards. To find out more about our wide range of GMP-grade proteins see page 6.

Animal Component – Free Process (ACFP) Manufacturing Conditions

For proteins that require eukaryotic expression, ACFP recombinant proteins are available. Expressed in an animal-free certified Sf9 insect cell line using dedicated animal-free laboratories, raw materials and labware, these meet standards needed for ex vivo research or bio-production.

With over 30 years of experience in producing the most trusted natural and recombinant proteins, R&D Systems produces proteins in a range of formats that give you choice and flexibility whatever your requirements.



GMP Grade Proteins

From Basic Research to Clinical Applications

Produced by expert scientists at our specialist facilities, we are proud to offer the widest range of quality recombinant proteins to aid research where Good Manufacturing Practices (GMP) are required.

All our GMP grade proteins maintain the performance expected from R&D Systems as well as being compliant with relevant regulatory guidelines* and supplied with all the documentation you need for your GMP applications.

Full Documentation and Tracibility

All proteins are produced in our ISO-9001:2008 and ISO 13485:2003 facility in Minneapolis USA. Full lot-to-lot consistency and material tracibility documentation can be supplied for every stage of manufacture – from initial cell culture to final fill and formulation.

Ideal for Transitional Research

We also offer proteins manufactured and purified exclusively under animal-free conditions. The proteins generated under animal-free conditions share the same biological activities as those produced using our standard research grade, easing the process of transition between protein formats.



*Manufactured in compliance of the applicable sections of World Health Organization TRS, No 822, 1992 Annex 1, Good Manufacturing Practices for biological products; USP Chapter 1043, Ancillary Materials for Cell, Gene, and Tissue-Engineered Products, and USP Chapter 92, Cytokines used in Cell Therapy Manufacturing. For research only. Not for use in diagnostic procedures.

Learn more | rndsystems.com/gmp

Bulk Quantities

Quality Protein on the Scale You Need

Ordering R&D Systems recombinant proteins in bulk delivers the same quality proteins you know and expect, but at the perfect price and scale for your research.

With trial vials available prior to purchase and discounts of up to 75% available for purchasing in bulk, contact us via our website or talk to your local representative to find out how much you can save.

We have the ability to scale up protein production to meet your large scale needs. All our recombinant proteins from research grade to GMP are available in bulk sizes.

Learn more | rndsystems.com/bulk

Custom Protein Services

Apply Our Experience to Your Research

When your research demands unique proteins or specialist solutions, R&D Systems can be your partner to achieve your aims.

Since 1985, R&D Systems has produced proteins to meet the highest development and purification standards and as part of Bio-Techne, we share expertise spanning laboratory research, pre-clinical studies, and reagents for manufacturing diagnostic tests.

Harnessing our decades of product development experience, our specialist protein solutions and custom services provide the unique tools and reagents required to accomplish your specific research goals.

Expertise and Communication

All projects start with an extensive consultation to capture all the specific project and performance requirements.

A team is assembled from our expert research and development scientists, manufacturing engineers, and project management staff.

Together, our expert team will work with you to deliver the protein that meets your required specifications.



From Cloning to Purification

From the initial cloning to the choice of expression systems and purification method - we can cater to any level of specification. Harness our specialist animal free and GMP grade protein facilities for your custom protein production.

Protein Modification & Processing

We can tailor in vitro modification and processing to meet your needs. Biotinylation, PEGylation, fluorescent probe conjugation and proteolytic cleavage are just some of the modifications available.

Expert Bioactivity Testing

No company matches the bioassay experience of R&D Systems. We have over 900 established bioassays available to test proteins, small molecules and antibodies.

Constantly Striving for Great Performance

We know that scientific progress doesn't stand still, and in developing research solutions neither do we.

From the daily challenges of the laboratory, changing reagent demands and emerging scientific trends, we are constantly challenged by our customers to solve their research demands. To be able to provide the best reagents and solutions to the

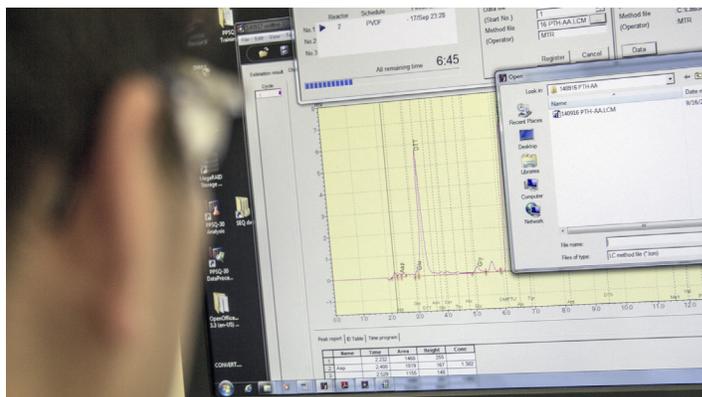
scientific community, their needs, challenges and demands are at the heart of the R&D Systems mindset.

Using our expertise and experience we develop innovative protein reagents, kits and solutions to help you solve your important scientific questions.

Protein and Process Engineering

From innovative purification processes to engineering proteins to increase biological activity, we employ the best knowledge and technology to create innovative new products.

See this in practice with our Recombinant Human Shh on page 9.



Bio-Activity – So What?

You may think that all recombinant proteins are created equally, but using poorly performing protein in your experiments could be wasting your precious research budget.

Better performing protein means you need to use less, therefore saving you money.

Evolution of a R&D Systems Protein

Changes in scientific understanding can alter the experimental requirements of proteins.

By keeping abreast of current thinking and research trends, we strive to constantly improve our proteins to keep up with the pace of scientific discovery.

Our expert protein design and production knowledge allows modification of essential protein tools in response to customer feedback to give you the best performance.

Recombinant Human Shh/Sonic Hedgehog

Shh is a secreted signaling protein essential for vertebrate development and critical for development of limb and central nervous system.

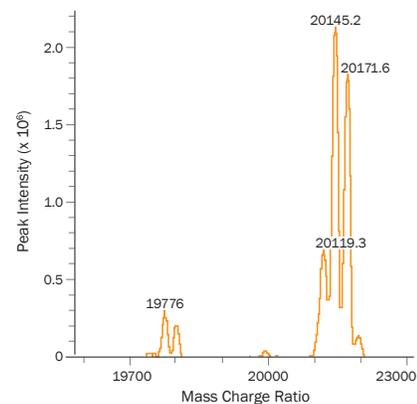
The highly processed Shh preproprotein is modified to produce 174 aa (Cys24-Gly197) active domain. N-terminal palmitate and C-terminal cholesterol modifications are essential for activity and function of the Shh signaling domain. Since its initial release in 2003, we have released three

different versions of Recombinant Human Shh. In the development of each new protein, we have modified both the method of production and sequence to provide increased biological activity.

Released in 2015 – the new Recombinant Shh High Activity (catalog # 8908-SH) – shows a 200-fold greater activity than other available Shh proteins.

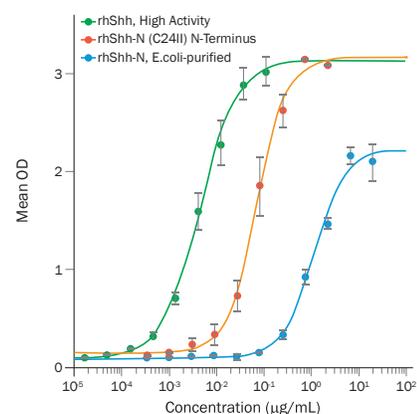
Post-translational Modification Analysis of Naturally-modified Recombinant Human Shh

LC/ESI-MS analysis of Recombinant Human (rh)Shh, High Activity (Catalog # 8908-SH) shows mass peaks at 20119 and 20145 Da, indicating that rh Shh is modified with a single cholesterol molecule at the C-terminus. The peak at 20172 Da indicates that rhShh is also modified with a single fatty acid at the N-terminus. The small mass peak at 19776 Da corresponds to rhShh modified with only cholesterol.



Naturally-modified Recombinant Human Shh is over 200-fold more active than other available Shh proteins

Recombinant Human Shh proteins induce alkaline phosphatase production when added to mouse mesenchymal stem cells. Recombinant Human Shh, High Activity (catalog # 8908-SH; green), purified from HEK293 cells and containing the correct post-translational modifications, is over 14-fold more active than E.coli-purified Recombinant Human Shh-N (C24II) N-Terminus (Catalog # 1845-SH; red line), and over 200 fold more active than E.coli-purified Recombinant Human Shh-N (Catalog # 1314-SH; blue line)



For Scientists by Scientists

Bringing you the best solutions

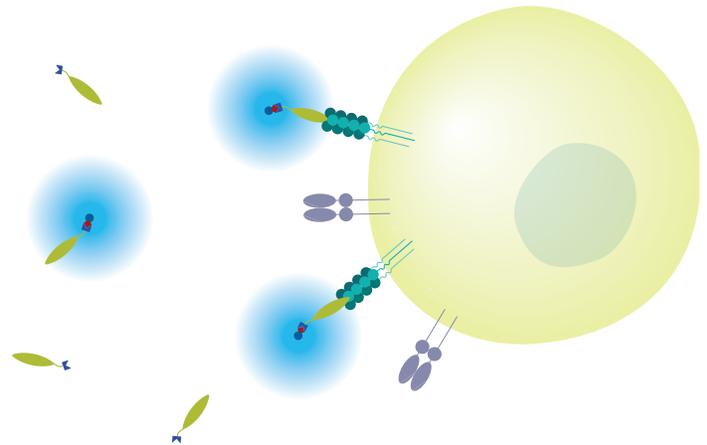
All R&D Systems proteins and products are born with the demands of our customers in mind, as they are developed by experienced researchers.

To make sure we bring only the best protein products to life, we use the latest science and technology, which ensures they are relevant and useful scientific tools.

Biotinylated Proteins

To help researchers understand physiological ligand/receptor interactions, versatile biotinylated protein harnesses the versatility of biotin and top quality R&D Systems proteins.

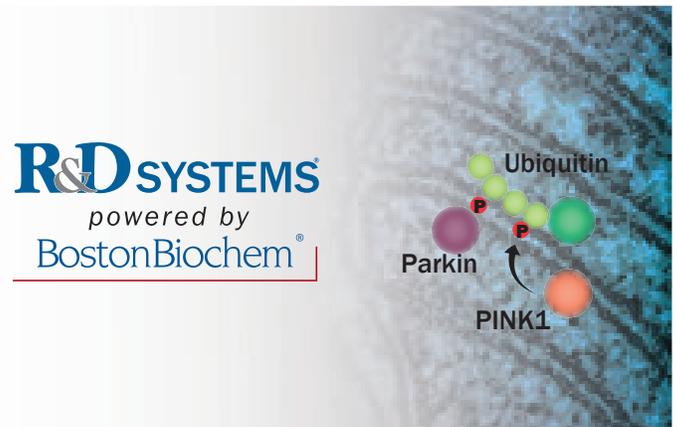
Our wide range of bioactive biotinylated proteins can be used in a wide variety of assays. When using streptavidin conjugates, the options for assay development to understand ligand expression and interactions are endless.



Ubiquitin Proteasome Solutions

Since 1997 BostonBiochem has provided ubiquitin proteasomal pathway (UPP) researchers with innovative tools that facilitate and accelerate research.

R&D Systems is now powered by Boston Biochem to bring you research essentials, such as ubiquitin, ubiquitin like proteins and their associated enzymes and other tools like substrates, inhibitors and time-saving kits.



Learn more | rndsystems.com

ProDots®

Let the good times roll

Maintenance of your cells in culture is essential, but reagent and media preparation can be time consuming. Save your time and do the lab work that really matters with ProDots®.

ProDots® proteins are proteins neatly packaged into easy-to-use pre-aliquoted lyophilized balls that can be rolled directly into cell culture media. The same R&D Systems protein quality – Just easier to use.

Eliminate Aliquoting

Pre-aliquoted ProDots® proteins allow quick reconstitution at your desired concentration. Revolutionary new lyophilization technology allows instant 100% reconstitution in cell media.

Avoid Freeze/Thaw Cycles

Guaranteed stable in your lab refrigerator for 6 months.

Learn more | rndsystems.com/prodots



CellXVivo™

Immune cell differentiation at its simplest

Variability is a major challenge of in vitro leukocyte maturation and the harvesting of mature human immune cells.

To simplify and increase consistency in your cultures, R&D Systems offers CellXVivo™ kits to expand and differentiate mature lymphoid and immune cell types from enriched population of peripheral blood mononuclear cells (PBMCs).

Efficient Immune Cell Differentiation

All kits contain simple validated protocols and cocktails of R&D Systems cytokines optimised for targeted lymphoid or myeloid lineages.

Reliable Yields

CellXVivo™ kits and cytokine cocktails are optimized for consistency time after time.

Learn more | rndsystems.com/cellxvivo

Immune Cell Differentiation as easy as . . .

1

Isolate
your starting immune population

2

Incubate
cells in the Cytokine Cocktail from your chosen CellXVivo™ Differentiation Kit

3

Verify
and quantify differentiation

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