Product Solutions for Viral Research Workflows

- Sample Collection, Isolation and Preparation
- Virus Identification
- Antibody Analysis
- Vaccine and Therapy Development
- Vaccine Manufacturing and QA/QC

Infectious viral diseases can attack quickly and without warning. Scientists and healthcare providers need to be prepared to address these challenges swiftly in order to minimize viral spread and accelerate vaccine development. Beckman Coulter Life Sciences provides laboratory automation solutions, genomic reagents, centrifugation solutions, cell health analysis instruments, flow cytometry solutions, particle counting and characterization tools and other laboratory instrumentation to support research workflows related to testing, research, vaccine production and biopharma manufacturing.
From isolation of viral particles, to their morphological, genotypic and phenotypic characterization, each method requires a uniquely qualified tool to produce reliable, quality results for viral identification. Sample workflows for viral detection and characterization can involve next generation sequencing (NGS), reverse transcriptase-polymerase chain reaction (RT-PCR), and enzyme-linked immunosorbent assay (ELISA) protocols. See the Beckman Coulter Life Sciences product offering for your pathogen identification workflow.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Sample</th>
<th>Products</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viral Isolation</td>
<td>Isolation and purification</td>
<td>Viral</td>
<td>Avanti JXN, Avanti J-15/R, Optima XPN, Optima MAX Airfuge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Our broad range of centrifugation products enable you to isolate virus from large or small volumes for downstream analysis.</td>
</tr>
<tr>
<td>Genotyping</td>
<td>Nucleic acid isolation for genotyping</td>
<td>Sample</td>
<td>RNAAdvance, DNAncle S, GenFind V3, FormaPure XL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Biomek i5 or i7</td>
</tr>
<tr>
<td></td>
<td>Genetic detection of the virus through automation PCR, qPCR, or RT-PCR</td>
<td>DNA RNA</td>
<td>Echo with/without Access Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Biomek i7</td>
</tr>
<tr>
<td></td>
<td>Construct the library for virus sequencing - identify genetic variants for evolutionary and epidemiological studies</td>
<td>DNA RNA</td>
<td>Echo with/without Access Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RNAClean XP, AMPure XP</td>
</tr>
<tr>
<td>Phenotyping</td>
<td>Viral characterization for surface expression of antigens</td>
<td>Particles, Cells</td>
<td>CytoFLEX with Violet Side Scatter</td>
</tr>
<tr>
<td></td>
<td>Characterize conformational changes, homogeneity, and shape for better understanding of the virus replication cycle.</td>
<td>Particle, Viral</td>
<td>Optima AUC</td>
</tr>
<tr>
<td></td>
<td>Monitor changes in cell morphology</td>
<td>Cells</td>
<td>Multisizer 4e</td>
</tr>
<tr>
<td></td>
<td>Cell brightness, roundness, granularity</td>
<td>Cells</td>
<td>Vi-CELL BLU</td>
</tr>
<tr>
<td>Morphology</td>
<td>Viron Isolation for downstream characterization and composition study</td>
<td>Particle, Cells</td>
<td>MoFlo Astrios EQ</td>
</tr>
<tr>
<td>Pathology</td>
<td>How the virus causes disease in target hosts (cellular morphology)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Beckman Coulter Life Sciences supports research workflows related to testing with automation, PCR setup and viral extraction kits. Our RNA and DNA isolation chemistries built on Solid Phase Reversible Immobilization (SPRI) paramagnetic bead-based technology enable purification of high-quality nucleic acid. These kits have demonstrated compatibility with saliva or transport media.

**Product Options**

- Avanti J-15/R high-speed benchtop centrifuge provides high-yield recovery of critical patient samples of cultured cells
- DNAAdvance
- GenFind V3
- BIomek i5
- Echo 525 Acoustic Liquid Handler
- Biomek i5 MC

**Visual Workflow of RNAdvance Viral**

1. Lyse tissue in LBF and Proteinase K
2. Bind RNA to magnetic beads
3. Separate magnetic beads from contaminants
4. Wash magnetic beads with WBE
5. Wash magnetic beads with 70% EtOH
6. Elute RNA from magnetic beads
7. Transfer to a new plate

The parallel processing of 96- or 384-samples on Biomek liquid handlers with RNAdvance Viral could greatly increase the RNA extraction throughput of many laboratories. RNAdvance Viral can successfully detect down to 1 copy/μL of RNA.

**Sample Preparation**

- DNA Extraction
- RNA Extraction
- PCR Setup, qPCR Setup
- RT-qPCR Reaction Setup
- Data analyzed for results

**Sample collected and stored in VTM, UTM**
High throughput automation can provide larger amounts of information on more samples, and serves as an important end-goal for antibody (Ab) research. Antibody research can show exposure to a certain antigen. Through exposure to the antigen, the immune system produces antibodies and/or cytokines.

**Antibody Research Workflow**

**Identifying IgM, IgG, IgE, IgD and IgA antibodies**

Instrument Configuration: Use a Biomek i5, Biomek Tips, and CytoFLEX flow cytometer with bead-based immunoassay for automating ELISA

- 96-well plates
- Throughput flexibility (medium-to-high based on need)
- Scale-up or scale-down flexibility

Direct integration of a CytoFLEX Flow Cytometer 1 to the Biomek i-Series Workstations enables complete automation of sample processing and data acquisition.

- CytoFLEX, a small footprint benchtop analyzer, can collect 13 fluorescence colors with high sensitivity.
- Automate the plating, drug treatment, trypsinization, and staining of cells for apoptosis and cytotoxicity analysis
- Selective tip pipetting enable serial dilutions and processing of partial plates for time course studies
- Measure dose and time responses for multiple compounds in both suspension and adherent cell lines
Vaccine and Therapy Development for Infectious Diseases

Though there is variation, vaccine development happens in 6 general stages.**

1. Exploratory Stage - Target Discovery and Validation
2. Pre-Clinical - Therapeutic Development and Pre-Clinical Testing
3. Clinical Development - Scale-up or scale-down, optimize and/or increase production
4. Regulatory Review and Approval
5. Manufacturing (Bulk Manufacturing)
6. Quality Control

### Exploratory Stage - Target Discovery and Validation

<table>
<thead>
<tr>
<th>Vaccine Candidate Type</th>
<th>Application</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation &amp; Preparation of Vaccine Strain</td>
<td>Nucleic Acid (DNA, RNA) Protein (mAb) Particle (multi-antigen, viral vector)</td>
<td>Avanti J-15/R Avanti JXN Series Optima XPN Optima MAX-XP</td>
</tr>
<tr>
<td>Genotyping</td>
<td>Nucleic Acid (RNA) based Screening</td>
<td>Automated Illumina RNA method</td>
</tr>
<tr>
<td>Phenotyping Protein expression of the viral target</td>
<td>Protein (mAb) based Functional assay. Characterize and quantify protein and nucleic acid interaction in-solution</td>
<td>Optima AUC</td>
</tr>
<tr>
<td>Morphology Size, shape and structure of virus</td>
<td>Particle (Inactivated Viral, viral vector) Particle size</td>
<td>LS 13 320 XR</td>
</tr>
<tr>
<td></td>
<td>Protein (mAb) based Protein Structure - characterization</td>
<td>Optima AUC</td>
</tr>
</tbody>
</table>

![Avanti J-15/R](image1.png) ![Avanti JXN](image2.png) ![Optima Ultracentrifuges](image3.png) ![Biomek i-Series](image4.png) ![Optima AUC](image5.png)
Therapeutic Development and Pre-Clinical Testing Instrumentation Solutions

Vaccine Development, Preparation, and Verification

Robotics / automated liquid handling solutions for cell culture applications

Minimize the labor-intensive bottlenecks in your lab through automation. As your throughput increases, the Biomek automated continuous cell culture solutions enable you to obtain results you can trace and rely on in an efficient manner, while managing multiple cell lines in parallel to increase efficiency, and reducing the wait time for bulk quantities of cell lines and assay plates for screening. Biomek solutions are developed based on your laboratory’s workflow.

Cell Culture Instrumentation

<table>
<thead>
<tr>
<th>Cell Counting / Viability Analysis</th>
<th>Cell Media Analysis</th>
<th>Robotics / Liquid Handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vi-CELL BLU</td>
<td>Vi-CELL MetaFLEX</td>
<td>Biomek i-Series</td>
</tr>
<tr>
<td>Fully automated sample prep</td>
<td>Monitor cell culture parameters for cell media health analysis</td>
<td>Biomek i-Series solutions provide reliable pipetting, integrated data management, and management software for the week to month long processes.</td>
</tr>
<tr>
<td>Minimum required sample volume as small as 170 μL for FAST mode and 200 μL for normal operation.</td>
<td>Measured parameters include pH, pCO₂, pO₂, cK⁺, cNa⁺, cCa²⁺, cCl⁻, cGlu, cLac</td>
<td></td>
</tr>
<tr>
<td>Facilitates 21 CFR Part 11 compliance</td>
<td>Facilitates 21 CFR Part 11 compliance</td>
<td></td>
</tr>
</tbody>
</table>

Genomic Chemistry Options

Our reagent portfolio is powered by Solid Phase Reversible Immobilization (SPRI) technology—widely known as the science behind AMPure XP—which uses paramagnetic beads to selectively bind nucleic acids by sequence size. It’s ideal for nucleic acid extraction from cells, tissue, blood and even challenging formalin-fixed, paraffin-embedded (FFPE) samples. Use our chemistries with manual and/or fully automated methods on your choice of platforms, for optimum performance, flexibility and scalability.

Separation parameters for cell harvest, purification, and other cell culture protocols

<table>
<thead>
<tr>
<th>Separation Parameters</th>
<th>Max Volume</th>
<th>Speed</th>
<th>Max g-Force</th>
<th>BioSafe Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avanti JXN-26</td>
<td>6 liters at 15,970 x g</td>
<td>500 to 26,000 RPM</td>
<td>81,770 x g</td>
<td>Yes</td>
</tr>
<tr>
<td>Avanti JXN-30</td>
<td>4 liters at 16,800 x g</td>
<td>500 to 30,000 RPM</td>
<td>110,500 x g</td>
<td>Yes</td>
</tr>
<tr>
<td>Avanti J-15/R</td>
<td>3 liters at 5,250 x g</td>
<td>200 to 10,200 RPM</td>
<td>10 to 11,420 x g</td>
<td>Yes</td>
</tr>
<tr>
<td>Optima XPN</td>
<td>1500 mL at 53,900 x g</td>
<td>Up to 100,000 RPM Up to 90,000 RPM Up to 80,000 RPM</td>
<td>802,400 x g 694,000 x g 548,300 x g</td>
<td>Yes</td>
</tr>
<tr>
<td>Optima MAX-XP</td>
<td>195 mL at 233,000 x g</td>
<td>150,000 RPM</td>
<td>1,019,000 x g</td>
<td>Yes</td>
</tr>
<tr>
<td>Airfuge Air-Driven</td>
<td>7 mL at 132,000 x g</td>
<td>110,000 RPM</td>
<td>199,000 x g</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Accelerating Answers

**Vaccine Manufacturing and QA/QC**

- **Raw Material Testing**
  - WFI & PW Analysis

- **Bioreactor Production Bulk Drug Product**
  - Cell Harvesting
  - Bioprocess Production QC
  - Clean in Place (CIP)

- **Drug Formulation and Stability Testing**
  - Product Efficacy QC
  - Drug Stability Formulation Testing
  - API & Drug Formulation Characterization, stability, & lot release

- **Pharmaceutical Release Testing / Final Product QC**
  - Sub-visible particulate counting for injectables/parenterals
  - Cell and sub-cellular volume determination, cell culture aggregate analysis

**Analytical Methods**

- TOC & Conductivity Analysis
  - Isolation & Separation
  - Mammalian Cell Viability, Concentration, and Bioreactor Cell Media Health Analysis
  - TOC & Conductivity Analysis

- Centrifuge to further clarify, density gradient to isolate.
  - Mammalian Cell Viability, Concentration, and cell media health

- Measure particles for final formulation
  - Analytical ultracentrifugation in-solution formulation characterization

- Count particulates for final product quality testing
  - Analytical ultracentrifugation in-solution formulation characterization

**Equipment**

- QbD1200
- ANATEL PAT700
- Avanti J-15/R
- Vi-CELL MetaFLEX
- Vi-CELL BLU
- QbD1200
- ANATEL PAT700
- Optima XPN
- LS 13 320 XR
- Optima AUC
- HiAC 9703+
- Multisizer 4e

**Routine Cleanroom Environmental Monitoring**

- MET ONE Facility Monitoring Systems
- MET ONE 3400+ Portable Air Particle Counter
- MET ONE HHPC+ Handheld Air Particle Counters
Better Biosafety

Biosafe Centrifugation Labware

Beckman Coulter offers a wide variety of labware designed to ensure biosafety during centrifugation. Our third-party tested and BioCertified Aerosolve canisters and bucket covers create a sealed, standalone containment system that’s easy to lift in and out of the rotor bucket. Labs also rely on our three-piece liquid tight cap assembly. Sample handling and exposure is further minimized by our easy-to-fill OptiSeal tubes with one-touch sealing, and disposable HarvestLine System Liners that retain hazardous pelleted samples for optimal safety.

BioCertified Aerosolve Canisters and Bucket Covers

- Protect from aerosol leakage and spills from rotor buckets
- Transparent design makes it easy to check for broken labware
- Can be autoclaved up to 121°C
- Bucket covers available for 1.5 mL tubes to 750 mL bottles
- Microplate carrier covers accommodate 96-well plate format

Biomek i-Series Automated Liquid Handlers with Enclosure

The Biomek i-Series can be configured with an enclosed perimeter protective system for additional environmental shielding around the instrument. It allows for safe handling of pathogens, contaminants, or other potentially hazardous materials.

- The system is compatible with an optional HEPA filtration unit(s).
- HEPA filters reduce contamination by providing environmental control.
- A diffuse-reflective light curtain along the front of the instrument
- Transparent safety shields along the left, right, and back sides of the instrument. An optional Conveyor Integration Side Panel is available to allow an external storage device to be connected to the Biomek i-Series instrument via a conveyor.
- A vertically-sliding front door that allows access to the instrument. Opening or closing the door does not affect the light curtain operation and will not stop the movement of the instrument.
- A halo that encloses the top of the instrument and protects the instrument from particulates.

Danaher Life Sciences Operating Companies

For the products you need that we don’t supply, we recommend reaching out to our sister life sciences operating companies in the Danaher network:

SCIEX
Pall Corporation
Phenomenex
cytiva
XIDT
Molecular Devices

1. For research use only. Not for diagnostic purposes. All other products identified are not for use in diagnostic procedures.
2. The Multisizer 4e, Vi-CELL BLU, and Vi-CELL MetaFLEX products are not for use in diagnostic procedures.

* RNAdvance Viral XP is listed as an extraction method for use with the Centers for Disease Control’s EUA-authorized COVID-19 test referenced in FDA’s FAQ on testing for SARS-CoV-2. Other than this designation, RNAdvance Viral XP is for research use, and not intended for diagnostic purposes.


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