Inside Chromium
Next GEM Technology
Resolving biology with scalable, single cell multiomic solutions

The Chromium platform, powered by Next GEM technology, enables integrated analysis of single cells at massive scale. Our suite of Chromium Single Cell products can capture molecular readouts of cell activity in multiple dimensions, including gene expression, chromatin accessibility, cell surface proteins, immune clonotype, antigen specificity, and CRISPR edits. The key to this technology is the ability to generate tens of thousands of single cell partitions, each containing an identifying barcode for downstream analysis. The Chromium family of instruments uses advanced microfluidics to perform single cell partitioning and barcoding in a matter of minutes.

How it works: From cells and nuclei to sequencing-ready libraries

1. Gel Beads, cells or nuclei, enzymes, and partitioning oil are loaded onto a Next GEM chip.

2. Within the Chromium instrument, barcoded Gel Beads are mixed with the cells or nuclei, enzymes, and partitioning oil to form tens of thousands of GEMS.

3. Each GEM acts as an individual reaction droplet in which the Gel Beads are dissolved and molecules of interest from each cell are captured and barcoded.

4. After barcoding, all fragments from the same cell or nucleus share a common 10x Barcode. Barcoded fragments for hundreds to tens of thousands of cells are pooled for downstream reactions to create short-read sequencer-compatible libraries.

The core of Next GEM Technology

At the core of Next GEM Technology are Gel Beads, each one coated with a unique oligonucleotide barcode sequence and assay-specific functionalized sequences to capture molecules of interest.

Using advanced microfluidics, Chromium instruments encapsulate Gel Beads in GEMS, or a “Gel Bead-in-emulsion,” along with a single cell or nucleus and reagents to create a micro-reaction.
Chromium assays

Chromium Single Cell Gene Expression
Chromium Single Cell Gene Expression provides single cell transcriptome 3’ gene expression and multomic capabilities to explore cellular heterogeneity, discover novel targets, and identify biomarkers with combined detection of surface protein expression or CRISPR edits in each cell. While Next GEM technology enables single cell analysis, Feature Barcode sequences expand the breadth of analytes that can be captured at single cell resolution.

**Assay input:** Whole cells or nuclei

Functionalyzed sequences on the Gel Bead enable capture of 3’ mRNA alone or in combination with Feature Barcode–labeled antibodies for cell surface protein analysis, or Feature Barcode–labeled CRISPR guides to link edits with cell phenotypes. Feature Barcode sequences are complementary to the Capture Sequences on Gel Beads.

Chromium Single Cell Immune Profiling
Chromium Single Cell Immune Profiling provides a multomic solution to tackle your immunology questions. Analyze full-length, paired B-cell or T-cell receptors (BCR/TCR), surface protein expression, antigen specificity, and 5’ gene expression, all from a single cell.

**Assay input:** Whole cells or nuclei

Functionalyzed sequences on the Gel Bead enable capture of 5’ mRNA alone or in combination with Feature Barcode–labeled antibodies for cell surface protein analysis, or Feature Barcode–labeled peptide–MHC multimers to measure antigen specificity. Pared full-length BCR/TCR genes can also be captured and sequenced.

Chromium Single Cell ATAC
Chromium Single Cell ATAC (Assay for Transposase Accessible Chromatin) allows you to analyze chromatin accessibility at the single cell level, providing insights into cell types and states and a deeper understanding of gene regulatory mechanisms.

**Assay input:** Nuclei

Functionalyzed sequences on the Gel Bead enable the capture of accessible chromatin fragments (from transposed DNA).

Chromium Single Cell Multiome ATAC + Gene Expression
Simultaneously profile gene expression and open chromatin from the same cell with Chromium Single Cell Multiome ATAC + Gene Expression. Multiply your power of discovery to characterize cell types and states, and uncover gene regulatory programs.

**Assay input:** Nuclei

Functionalyzed sequences on the Gel Bead enable the dual capture of accessible chromatin fragments (from transposed DNA) and 3’ mRNA.
**Extend your capabilities**

Sample multiplexing with 3' CellPlex

Scale your single cell studies with an end-to-end sample multiplexing solution, utilizing species-agnostic tags. Enabled by Feature Barcode technology, 3' CellPlex lets you combine up to 12 samples and recover up to 45,000 singlets* in a single channel, or 750,000 singlets per chip.

Compatible assays: Chromium Single Cell Gene Expression

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**Targeted Gene Expression**

Profile a defined set of transcripts to reduce sequencing costs while increasing sample number or sequencing depth with customizable, comprehensive gene panels.

Compatible assays: Chromium Single Cell Gene Expression, Chromium Single Cell Immune Profiling

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**Chromium Single Cell workflow**

The Chromium platform is a transformative technology that fits easily into your existing lab infrastructure. This end-to-end single cell sequencing solution includes sample preparation support and turnkey data analysis and visualization tools.

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**Targeted Gene Expression panels**

Add up to 200 genes to pre-designed panels with the Custom Panel Designer

<table>
<thead>
<tr>
<th>Panel Type</th>
<th>Number of Genes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Pan-Cancer Panel</td>
<td>1,253 genes</td>
</tr>
<tr>
<td>Human Immunology Panel</td>
<td>1,096 genes</td>
</tr>
<tr>
<td>Human Gene Signature Panel</td>
<td>1,142 genes</td>
</tr>
<tr>
<td>Human Neuroscience Panel</td>
<td>1,186 genes</td>
</tr>
<tr>
<td>Custom Human or Mouse Panels</td>
<td>10–1,500 user-defined genes</td>
</tr>
</tbody>
</table>

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Starting with single cell or nuclei suspensions, each sample is stained with a unique lipid tag, then pooled and loaded onto a Chromium Next GEM chip. During the Single Cell Gene Expression workflow, mRNA, 3' CellPlex sample tags, and, if desired, protein or CRISPR guide RNAs are barcoded to identify individual GEMs. After sequencing, the samples are then bioinformatically demultiplexed with Cell Ranger software.

*Singlets are single cells or nuclei after multiplet removal.*
**Chromium instrument family**

Chromium instruments use advanced microfluidics to perform single cell partitioning and barcoding in a matter of minutes, enabling a seamless workflow from single cell or nuclei suspensions to sequencer-ready libraries.

<table>
<thead>
<tr>
<th></th>
<th>Chromium X Series</th>
<th>Chromium Controller</th>
<th>Chromium Connect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instrument dimensions</strong></td>
<td>11.25&quot; x 19&quot; x 10.75&quot;</td>
<td>7.9&quot; x 10.3&quot; x 6.4&quot;</td>
<td>42&quot; x 28&quot; x 35&quot;</td>
</tr>
<tr>
<td><strong>Instrument weight</strong></td>
<td>414 lb (18.8 kg)</td>
<td>12.5 lb (5.6 kg)</td>
<td>350 lb (158.8 kg)</td>
</tr>
<tr>
<td><strong>Supported workflow</strong></td>
<td>Manual</td>
<td>Manual</td>
<td>Automated</td>
</tr>
<tr>
<td><strong>Supported single cell assays</strong></td>
<td>All assays and throughputs (low, standard, and high)</td>
<td>All assays; standard and low throughputs only</td>
<td>Gene Expression Immune Profiling</td>
</tr>
</tbody>
</table>