CELL Microsystems®

BioFlux

Shear Flow Systems

Emulate physiological conditions to reveal *in vivo* biology

Well-plate Throughput with Physiological Relevance

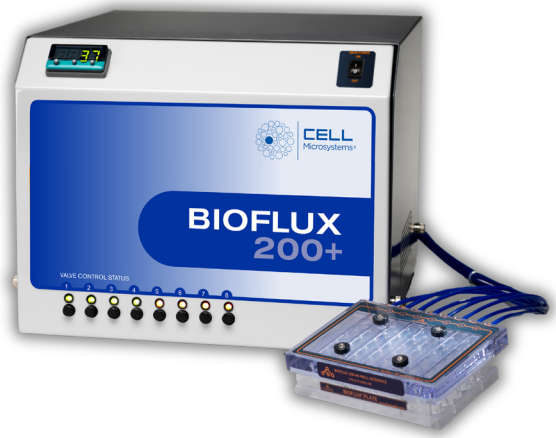
Many physiological processes take place under flow conditions. BioFlux Shear Flow Systems provide a straightforward way to increase throughput and improve the physiological relevance of in vitro investigations by mimicking in vivo environments within a well plate format. Thoughtful engineering and precise calibration enable accurate control of shear flow, temperature, and gas concentration, empowering investigators with the ability to collect high-quality images and videos at a rate that no other system can offer.

The Power of Shear Flow

Culturing and assaying cells under shear flow provides several advantages over static conditions. Benefits of BioFlux include:

- High throughput platform with up to 24 flow cell assays on a single plate
- Bridge the gap between in vitro and in vivo experiments with controlled, physiological shear flow up to 200 dyn/cm^2
- Well plate simplicity – standard format, pre-sterilized, no tubing to change
- Glass bottom plates for superior imaging quality or custom options for more complex experimentation
- Capability for two-phase flow, alternative gas (hypoxia, etc.), dual gas, and temperature-controlled experiments

BioFlux 200+



The BioFlux solution for your existing microscope. Compatible with most inverted microscopes.

BioFlux 1000HT

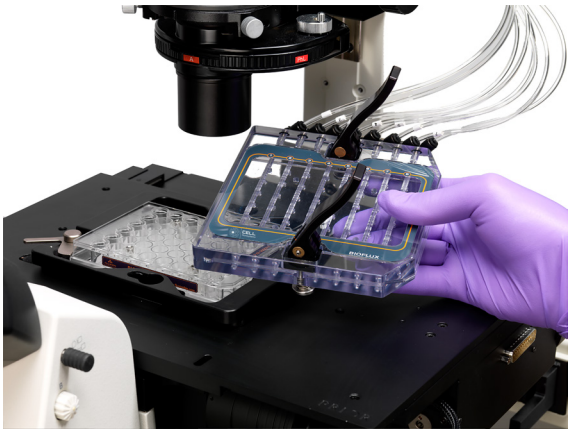
The turnkey, fully-loaded, customizable BioFlux solution for ultimate imaging flexibility and throughput.

Straightforward Use

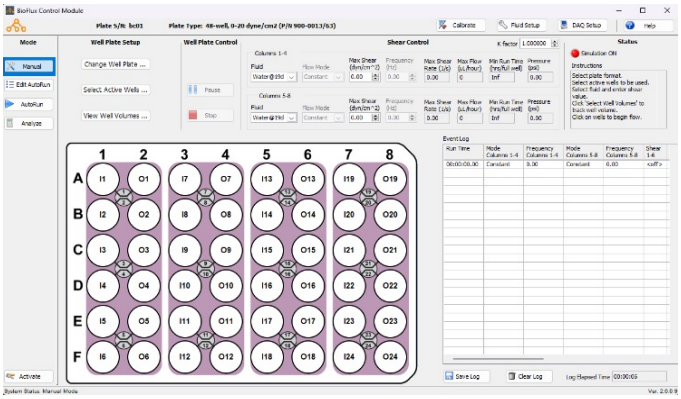
BioFlux systems provide the highest degree of shear flow control available. The microfluidic well plate design enhances reliability and reproducibility far beyond the capabilities of “do-it-yourself” parallel plate flow chambers, without the complications of pumping liquid through tubes. BioFlux provides the ability to flow up to 24 experiments in parallel and image in series, effectively reducing large projects from months to days. BioFlux 200+ can be integrated with most inverted microscopes*, while BioFlux 1000HT is equipped with a high-resolution microscope and automated stage, perfect for capturing stunning data in high throughput.

1. Pipette cells into the BioFlux plate.

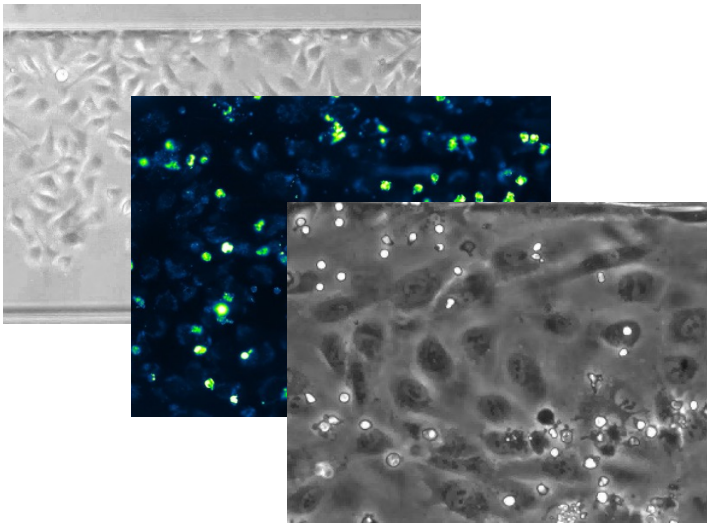
2. Attach the plate interface.



3. Enter the desired parameters (wells to be used, shear rate, flow direction, time) into the software.



4. Collect and analyze images/videos.

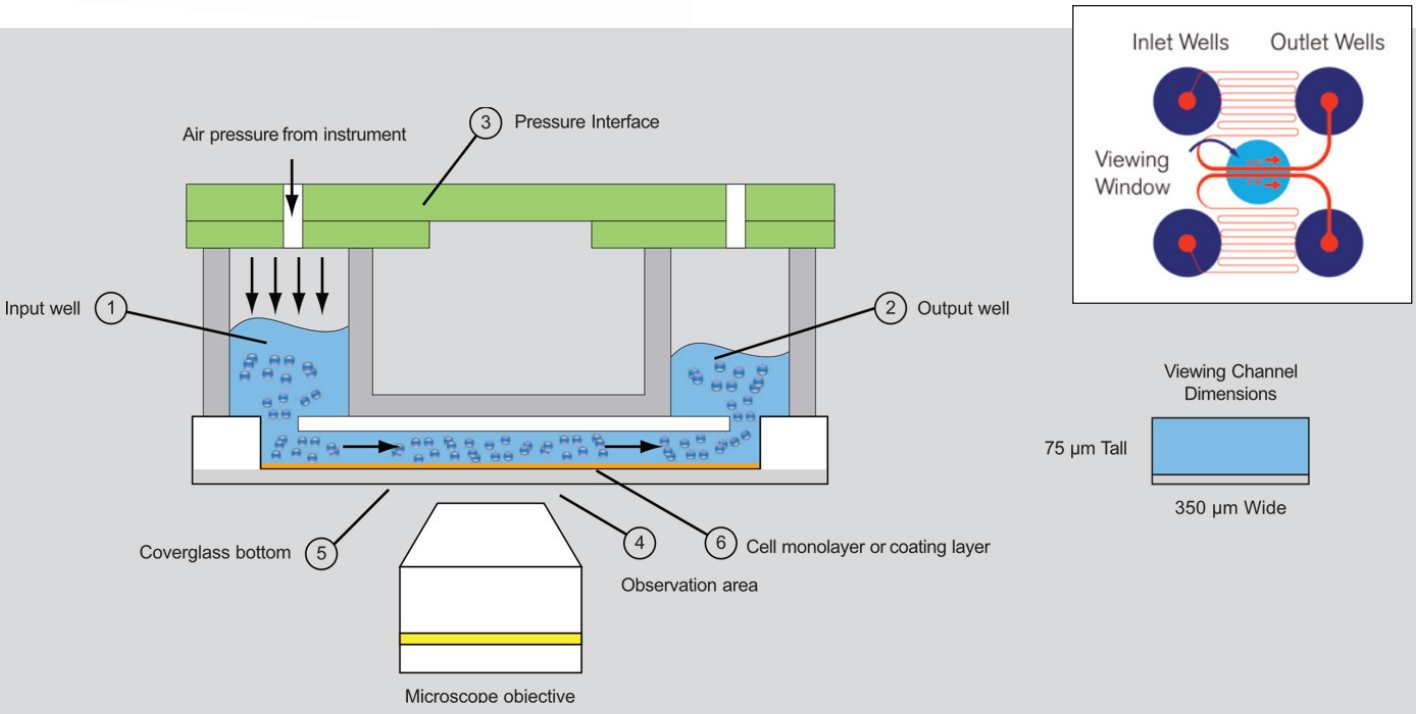


* Provided that certain components are in place.

How it works

BioFlux utilizes innovative well plate microfluidic technology to embed micron-scale fluidic channels to the bottom of a standard-sized well plate. Powered by a pneumatic pump, the BioFlux interface uses positive air pressure to drive flow along the microfluidic channels at a rate that elicits the user-defined shear rate. Coverslip glass allows for high-quality imaging of the microfluidic channels through viewing windows located between pairs of experimental wells.

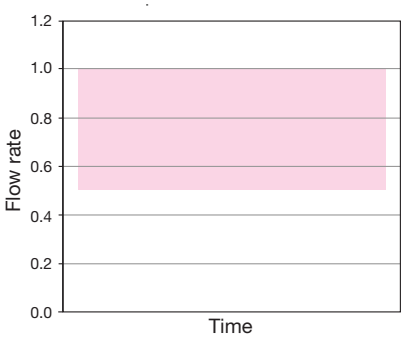
View from underneath a 48-well plate.



Because all cells and reagents are completely contained within the plate, there are no tubes to clean, no leaks to worry about, and the risk of cross-contamination is greatly reduced in comparison to other shear flow setups.

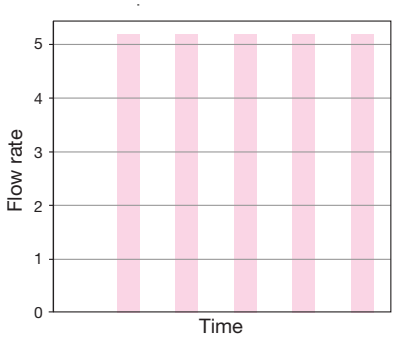
Laminar Flow to Meet Your Needs

Shear stress plays an important role in creating physiologically relevant models to answer fundamental questions in cellular biology. The flexible flow rates and patterns provided by BioFlux have been cited in hundreds of peer-reviewed publications across a broad array of disciplines and applications.



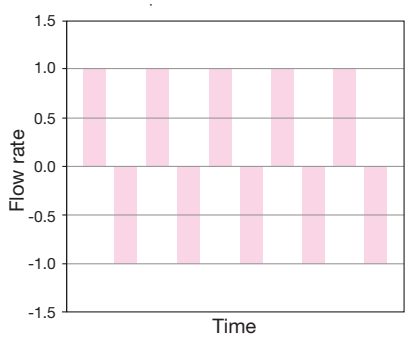
Unidirectional

BioFlux provides steady constant flow direction and rate, which is typical in most small healthy blood vessels and biofilm environments.



Pulsatile

BioFlux provides unidirectional flow rates that can be programmed to periodically start and stop, which can be used to simulate large artery and myocardial blood flow.



Oscillatory

BioFlux can be programed to mimic saliva or pathophysiological flow by reversing the direction of flow at regular intervals. Different flow rates can be used in each direction.

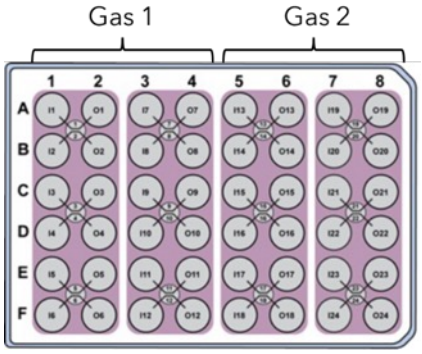
System Features

Environmental Control

BioFlux 1000HT is equipped with a heated microscope stage while BioFlux 200+ has an optional plate heater. Heat can be increased to 50°C for both systems. BioFlux systems can be run using controlled gas (e.g., 5% CO_2) rather than ambient air. Ideal for long-term culture and for studying conditions such as hypoxia.

Dual Gas

Dual gas control allows for 2 separate gas sources to be used to generate gas gradients when using 24-well plates or to compare the effects of different gas conditions on cell function. Gas sources can be combined across an entire 24-well plate or individual gases can be run simultaneously on each half of a 48-well plate.



Gas sources can be split between a 48-well plate (Above).

Shear flow is a critical physiological factor in many areas of biology and drug discovery

Jackson, et al.
Arterioscler. Thromb. Vasc. Biol.26;663-669

Plate Configurations

48-Well Low Shear Plates (0-20 dyn/cm²)

48-Well High Shear Plates (0-200 dyn/cm²)

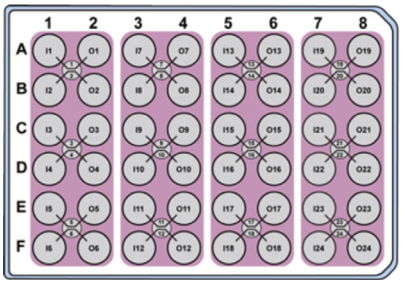
With one inlet well and one outlet well per experimental channel, up to 24 assays can be run on one plate.

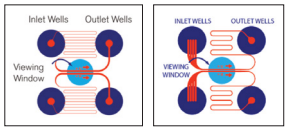
24-Well Low Shear Plates (0-20 dyn/cm²)

24-well plates feature 8 experimental channels, each with two input wells that are independently controlled. Inlet wells can also run simultaneously, to create two non-mixing parallel liquid streams with a gradient at the juncture.

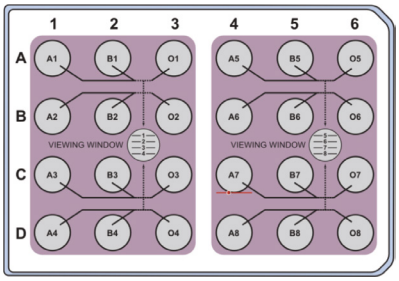
6-Well Plates (0-60 dyn/cm²)

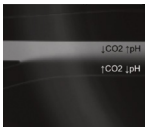
Ideal for long-term cultures/experiments. They feature 3 experimental channels. **6-well plates can only be used with BioFlux 1000HT.**





Low shear High shear





CO_2/pH gradient

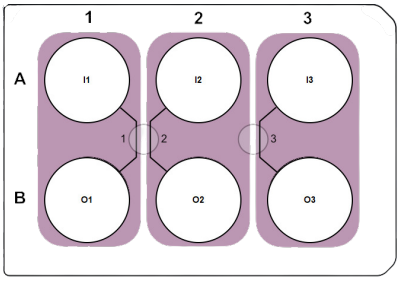
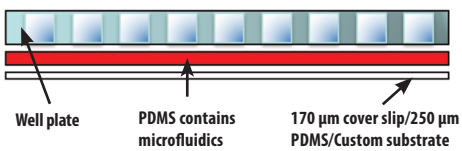


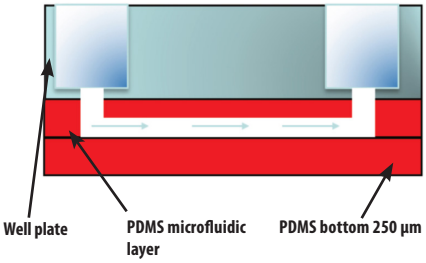
Plate Composition

Available plate compositions	Common applications
Standard coverslip glass bottom	Brightfield, phase, fluorescence, confocal imaging
Polydimethylsiloxane (PDMS)	Microbiological assays, medical device infection modeling
Custom substrate	Maintains optical access with **a fully customizable growth surface**

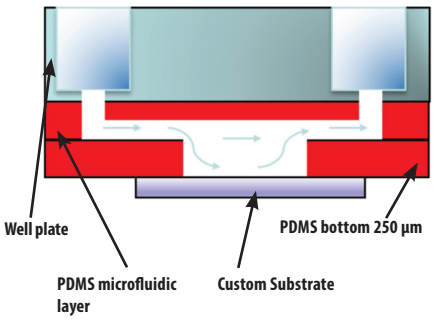
Standard Glass Bottom



PDMS Bottom



Custom Substrate

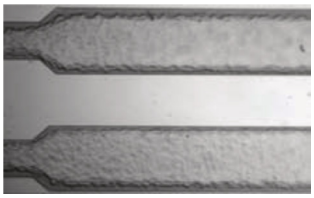


Assay Flexibility

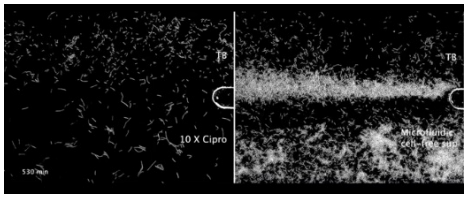
The flexibility of BioFlux Shear Flow Systems have been demonstrated in 20+ assays published in hundreds of peer-reviewed papers. In addition, the wide range of plate selections and custom substrate possibilities make BioFlux Shear Flow Systems ideal for developing custom assays that fit your experimental needs. Some examples of common BioFlux assays include:

Microbiology

- Biofilm growth
- Antimicrobial screening
- Host-pathogen interactions
- Motility



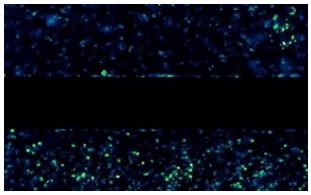
Pseudomonas aeruginosa biofilms grown under shear flow in BioFlux microfluidic channels.



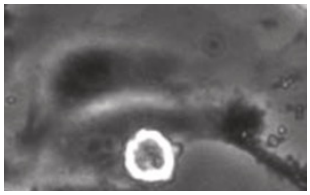
Pseudomonas aeruginosa chemotaxis with (left) and without (right) antibiotic treatment.

Immunology

- Leukocyte adhesion cascade
- Adhesion strength
- Cell differentiation
- Chemotaxis



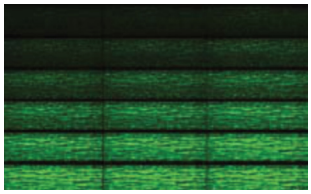
Neutrophil adhesion with vimentin (top) and under control conditions (bottom).



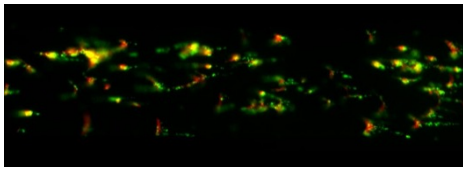
A colon carcinoma cell (HT29) transmigrating through an endothelial cell under shear flow.

Hematology

- Platelet activation
- Platelet rolling
- Platelet adhesion
- Platelet aggregation



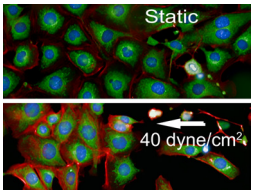
Platelet aggregation on vWF under high shear for 10 minutes with calcein AM-labeled whole blood.



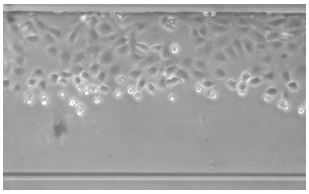
Calcien (green) labeled human platelet aggregation with rhodamine-B labeled (red) synthetic nanoparticles.

Vascular Biology

- Atherosclerosis modeling
- Vascular permeability
- Cell adhesion
- Wound healing



Endothelial cell alignment without (top) and with (bottom) shear flow.



Clean and consistent enzymatic wounding of a HUVEC monolayer with trypsin using a 24-well plate.

System Specifications

System	BioFlux 200+	BioFlux 1000HT
Throughput	Up to 24 flow assays	Up to 24 flow assays
Temperature control	Configurable	Configurable
Pulsatile flow	✔	✔
Environmental Control	✔	✔
Dual gas	✔	✔
Plate formats	48-well, 24-well (2 inlet)	48-well, 24-well (2 inlet), 6-well
Microscope	Inverted (not included)	Customizable inverted microscope, equipped with a programmable automated stage
Software	BioFlux control software included, Montage Plus analysis software optional	Advanced microscope control and analysis with Montage Plus software
One-phase flow applications		
Platelet aggregation	✔	✔
Biofilm formation	✔	✔
Host-pathogen interactions	✔	✔
Rolling/adhesion	✔	✔
Stem cells	✔	✔
Transmigration	✔	✔
Two-phase flow applications		
Chemotaxis	✔	✔
Wound healing	✔	✔
Migration/ invasion	✔	✔
Cell homing	✔	✔
Angiogenesis	✔	✔

For more information on BioFlux Technology, visit cellmicrosystems.com/BioFlux

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