Time lapse imaging system

BioStation IMQ

Combining a microscope, incubator and high-sensitivity digital camera into one powerful system

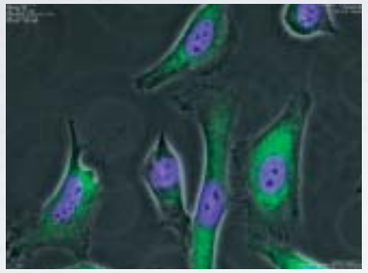
Live Cell Imaging Solutions

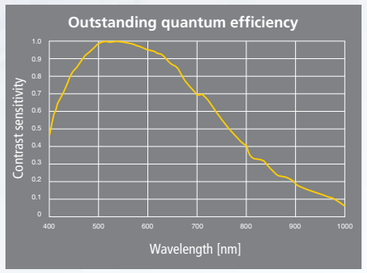
The perfect solution for long-term, time-lapse, live-cell imaging

The BioStation IM-Q incorporates a microscope, an incubator and a high-sensitivity cooled CCD camera in a compact body. This all-in-one package provides a stable environment for live cells and advanced solutions for simple long-term time-lapse data acquisition.
Moreover, focus drift caused by thermal change and mechanical instability has been minimized, and fail-proof data acquisition is possible even during lengthy time-lapse imaging.
The BioStation IM-Q eliminates the need for a darkroom for fluorescence imaging, meaning it can be installed anywhere.

Exceptional high-sensitivity fluorescence images

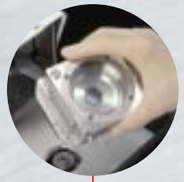
The high sensitivity of the built-in CCD camera, equivalent to ISO800, reduces exposure time, which minimizes photobleaching and damage to specimens while increasing throughput for multipoint acquisition. The cooling mechanism prevents heat-induced noise and allows even weak fluorescence to be captured. The fluorescence equipment employs a noise terminator mechanism in order to eliminate stray light. This enables high-contrast imaging with high S/N ratios.



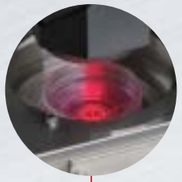


Cell-friendly environmental control

Cell culture and image capture functions are beautifully integrated. No complex setup or alignment procedures that conventional time-lapse observation systems require are necessary. The vibration-proof and heat-insulated structure enables stable image acquisition even over long periods.

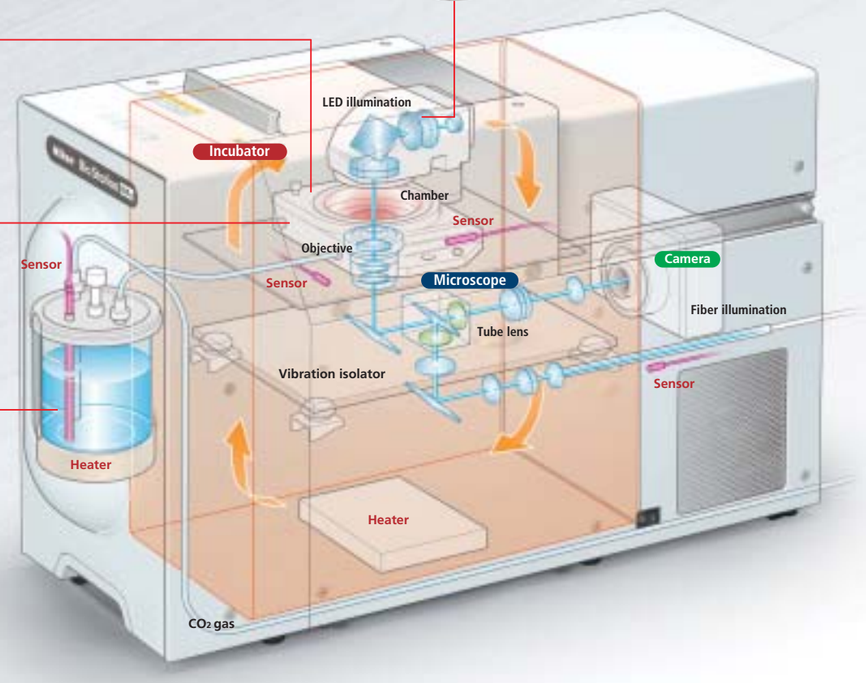


The standard specimen chamber can be sterilized in an autoclave (a high-temperature, high-pressure steam sterilizer).



Red LED illumination is used for phase contrast imaging. The fluorescence illuminator shutter opens only when capturing images, therefore reducing phototoxicity of live cells.

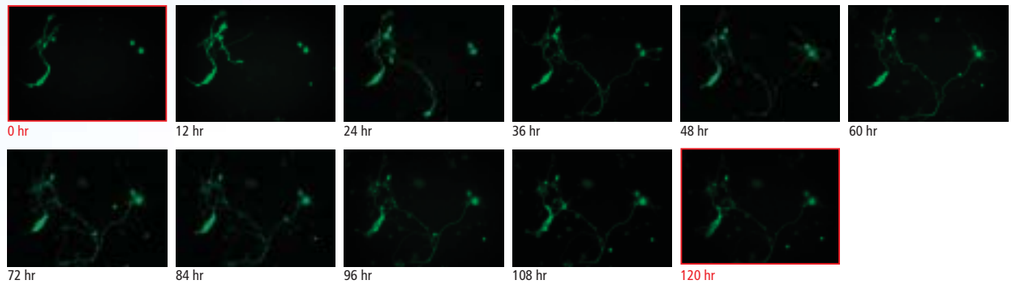
BioStation IM-Q contains four sensors for precise control of an environment of 37 °C. In addition, the humidifier maintains a humidity level of 95 % or higher and the CO_2 gas mixer provides a stable supply of CO_2 of 5 % concentration.



Accurate recording of live-cell dynamics over a number of days

Focus drift during lengthy time-lapse observations has been greatly reduced, enabling reliable time-lapse imaging even for several days. The temperature of the chamber, the chamber exterior and microscope unit is precisely controlled with built-in heaters and fans. The focusing mechanism is made from thermal-stable materials and is therefore resistant to thermal expansion. Moreover, BioStation IM-Q moves the objective lens instead of the stage. This eliminates focus drift caused by vibration of culture dish, minimizing stress on the cells.

Lengthy time-lapse imaging without focus drift
Membrane-anchored GFP of rat hippocampal neurons was captured in 120-hour time-lapse imaging.



Photos courtesy of: Dr. Chieko Nakada, Dr. Yuuri Nemoto, Dr. Hiroko Hijikata, Dr. Akihiro Kusumi, Institute for Integrated Cell-Material Sciences, Kyoto University

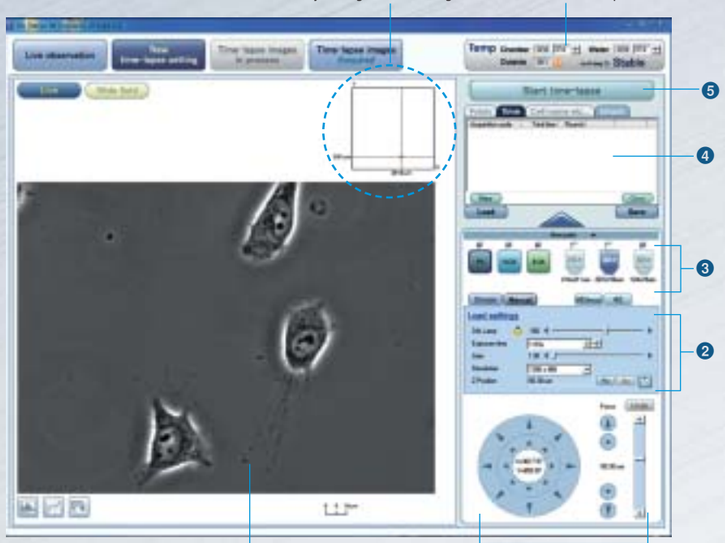
Simple and easy operation

Operation from a PC

BioStation IM-Q provides fully motorized control from a PC, allowing users who are not accustomed to operating a microscope or camera to easily conduct time-lapse imaging. The user only has to set the culture dish in place and program the image recording. Everything from cell management to time-lapse imaging is automatically managed and accomplished.

1 Culture dish setup

2 Setting with intuitive GUI



1. Set live image location with XYZ movement control.
2. Configure imaging condition.
3. Select illuminations, filters and magnifications.
4. Input imaging time interval.
5. Start time-lapse imaging.

3 Time-lapse imaging and analysis

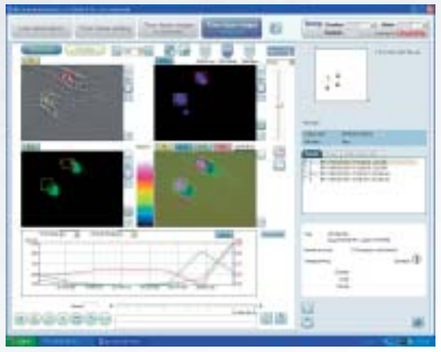
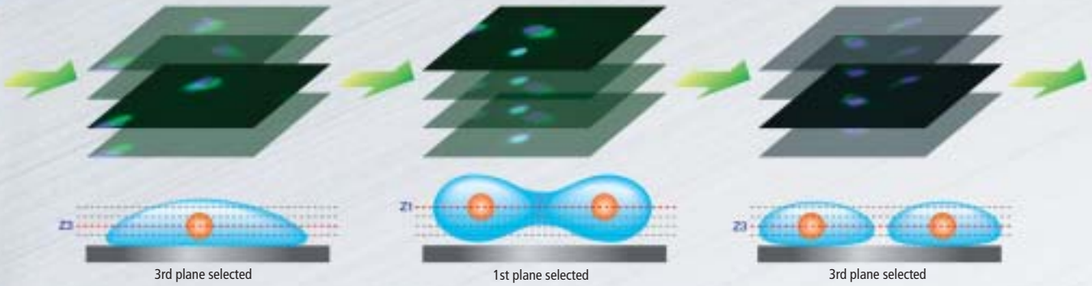


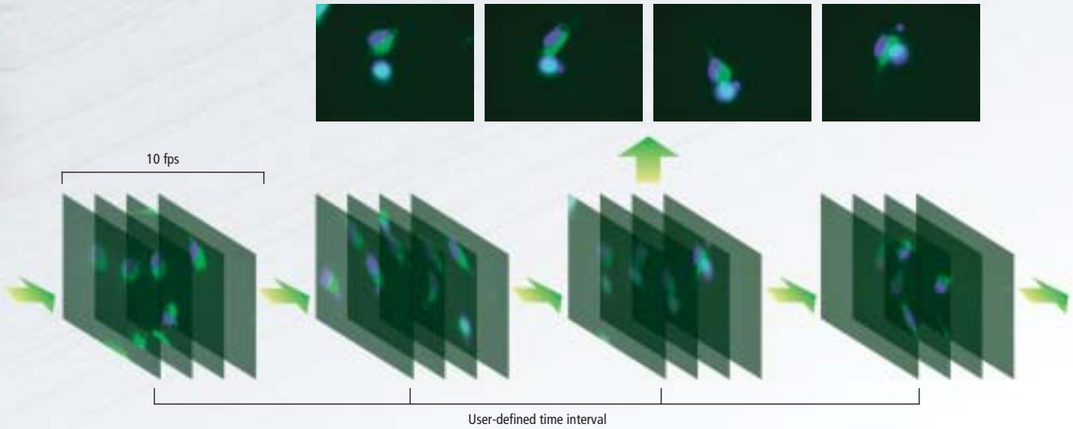
Image file output at desired Z-axis planes

Images at different Z-axis planes can be selected from the captured Z-stack images at each time point and assembled into a seamless movie file. This is optimal for imaging a specimen in which the observation point moves along the Z-axis direction, such as with cell division.



Streaming function

Rapid motion changes such as cardiomyocyte beats are captured by high-speed 10-fps imaging at user-defined time intervals.



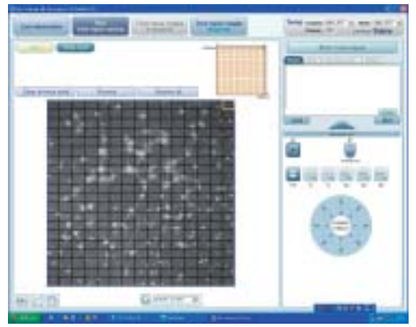
Ergo controller

An ergo controller allows X, Y and Z directional movement with an operational feel similar to a microscope. It also allows changeover of magnifications, fluorescence filters, imaging/observation methods and fluorescence shutter ON/OFF.

Widefield display

Because a wide 6 mm x 6 mm area can be displayed by image stitching, the point of time-lapse observation can be easily specified from the widefield image.

Widefield display screen

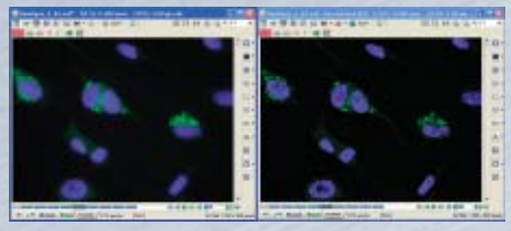


Two kinds of analysis software are available for intended use. (Option)

Imaging software NIS-Elements Ar

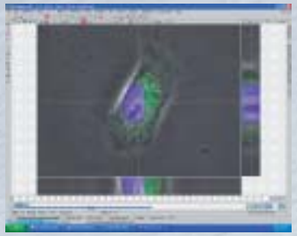
Nikon's proprietary imaging software NIS-Elements Ar allows multi-dimensional image capture, image processing, and data management and analysis of up to 6D.
Its intuitive interface simplifies workflow and contributes to archiving and searching of large numbers of Z-stack sequence image files.
It also offers diverse optional plug-ins to support sophisticated, cutting-edge research applications.

Deconvolution
Haze and blur of an image that can occur when capturing a thick specimen or a fluorescence image can be eliminated from the captured image.

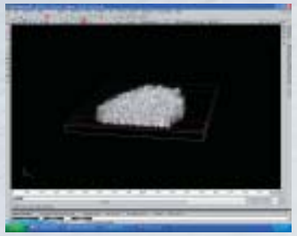


Cell counting
Images are processed by image analysis routines and the extracted objects can be counted. Their areas and intensities are recorded.

Slice view
Images in three orthogonal planes (sliced images along the XY-, YZ-, and ZX-planes) can be viewed in a single display.



Volume rendering
3D images can be reconstructed from captured Z-stack images.



Dedicated image analysis software for BioStation series—CL-Quant

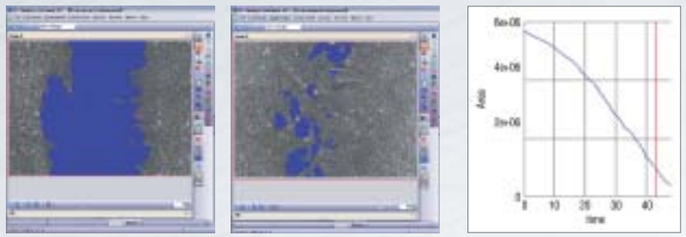
Cell detection in phase contrast images

CL-Quant automatically detects and measures the cellular area in unstained, label-free phase contrast images. Unique image processing algorithms provide accurate thresholding of phase contrast images, which enables non-invasive quantitative analysis of cells. Cell detection accuracy can be improved through a learning function process.

Analysis option: cell counting, scratch (wound) test, growth curve, tracking, stem cell colony analysis

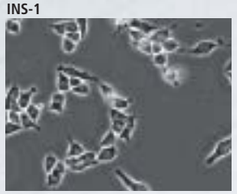
Scratch (wound) test quantification

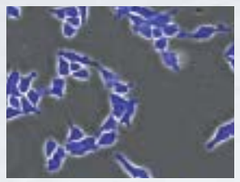
CL-Quant automatically segmented the acellular area (blue) in the time-lapse cell migration images that were captured at the beginning (left) and on the second day (right) of a 2-day phase contrast observation. The graph indicates how the acellular area decreased.



Cell detection samples

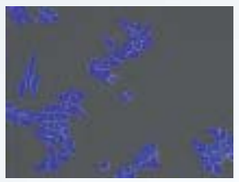
INS-1


Original image


Segmented image

PC12


Original image

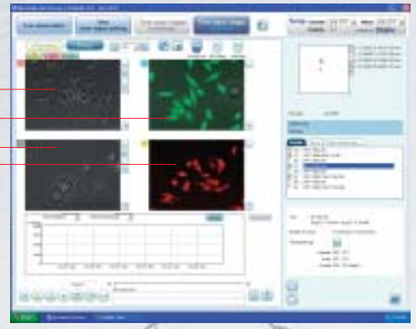

Segmented image

Optional accessories broaden the range of applications

Motorized chamber for four-well culture dish

Automated changeover allows each of the four culture wells to be imaged. Observation of four different conditions is possible in a single time-lapse experiment, facilitating comparative analyses.


Lab-Tek™ chambered coverglass (Cat. No. 155383, Nunc™)

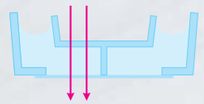

Operation screen

Specialized Hi-Q4 culture dish that enables multi-sample observation

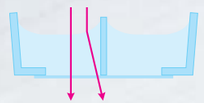
This new 35 mm culture dish is divided into four parts and has an incorporated plane parallel top plate. The plate prevents light path distortion by the meniscus, which is the curve at the air-water interface, and enables high-quality phase contrast observation. The observation points in the quadrant of the Hi-Q4 dish can be easily set using BioStation IM-Q software. An adapter is provided to store the Hi-Q4 dish in the right position.

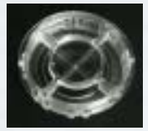
*Use of the Hi-Q4 culture dish is available for the BioStation IM-Q CELL-S2 unit only.
*Patent pending

Dish with plate (Hi-Q4)


The absence of a meniscus allows light to pass though without refraction.

Dish without plate


Light refracted by the media's meniscus causes distortion and poor phase image.


Hi-Q4 dish


Observation with four different combinations of medium and reagent can be conducted.

Perfusion components

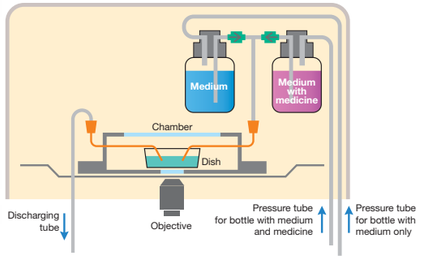
The perfusion components allow reagent administration and medium exchange without a change to the culture environment. This apparatus comprehensively supports live-cell research, such as lengthy time-lapse imaging. Researchers can add drugs or medium supplements to their cultures or collect waste products for further analysis.

*Perfusion components cannot be used with a Hi-Q4 culture dish or a motorized chamber for a four-well culture dish.

- The compact unit can be stored inside the temperature controlled section of BioStation IM-Q. A waterbath to pre-equilibrate the medium or medium supplements prior to adding to the culture is not required.
- Two bottles can be stored. Retrieval of the medium after reagent administration enables the clear determination of medicinal effects.
- All perfusion components can be sterilized in an autoclave.


Quick and easy reagent administration with a single button

Two-bottle installation

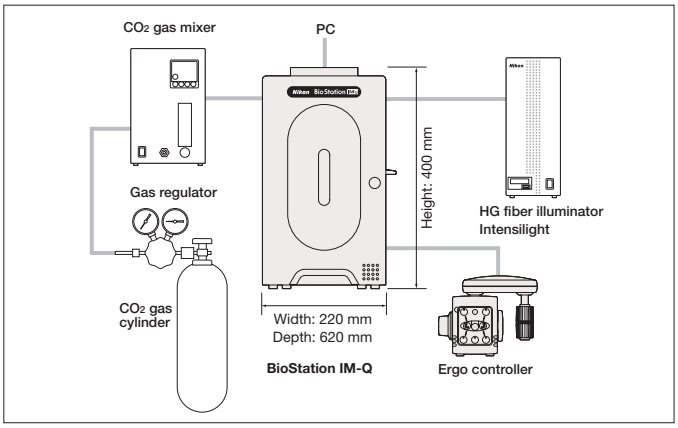


*Syringe pump or peristaltic pump is necessary to pressurize the solution bottles.

Specifications

	CELL-S2 (for glass bottom dish)	CELL-S2-P (for plastic bottom dish)
Temperature control	37 °C ± 0.1 °C	
Humidity control	95 % or higher	
Water supply for humidification	Built-in bottle (270 ml)	
CO_2 supply	Concentration and flow volume set by external mixer	
Observation vessel	ø35 mm glass bottom dish, Hi-Q4 ø35 mm culture dish, Nunc™ Lab-Tek™ chambered coverglass (Cat. No. 155383, for the motorized chamber), Glass slide	ø35 mm plastic bottom dish, Glass slide
Diascopic phase contrast observation	Phase ring DL Illumination: red LED	
Epi-fluorescence observation	Illumination: external mercury illuminator Intensilight via fiber cable, Filter cube: up to two can be mounted, Field diaphragm: rectangular diaphragm switch interacting with the objective changeover, Built-in noise terminator	
Objective lens magnification	40x (20x, 40x, 80x by switching tube lens), NA 0.8	20x (10x, 20x, 40x by switching tube lens), NA 0.5, with correction ring
Camera	High-sensitivity 1.3-megapixel cooled monochrome camera Recording pixels: 1280 x 960, 640 x 480 (binning)	
Data format	ICS-IDS, JPEG, BMP, Tiff, PNG (still), AVI (movie)	
Imaging area	XY: 6 x 6 mm (by objective lens movement), Z: 1.25 mm	
Time-lapse	Up to 99 XYZ-positions can be set. AVI image file output at desired Z-axis and 10-fps imaging at time intervals are possible.	
Image stitching	Allows composition of large-area images of 6 mm x 6 mm	
Analysis functions	Tone curve adjustment, saturation indicator, light intensity screening, light intensity record display, ratio display, image blur adjustment, etc.	
Temperature record	Graph display	
Power consumption	1160 VA (IM-Q: 300 VA, illuminator Intensilight: 130 VA, PC: 475 VA, display: 55 VA, gas mixer: 200 VA)	
Dimensions	220 (W) x 620 (D) x 400 (H) mm (excluding protrusions)	
Weight	Approx. 30 kg (main body only)	

System diagram



Introduction case

Fraunhofer IBMT

Fraunhofer Institute for Biomedical Engineering

Department Biophysics & Cryotechnology (Prof. Dr. H. Zimmermann and M. Gepp, M.Sc.), Fraunhofer IBMT, which conducts cell management and technological development of long-term storage, freezing and thawing, introduced 10 BioStation IM into their laboratory to efficiently conduct the experiments and is researching to improve culture conditions by simultaneously running multiple experiments with BioStation IM.

Contact:
michael.gepp@ibmt.fraunhofer.de

Research papers stating data obtained with BioStation IM

- Karine Gousset, Edwin Schiff, Christelle Langevin, Zrinka Marijanovic, Anna Caputo, Duncan T. Browman, Nicolas Chenouard, Fabrice de Chaumont, Angelo Martino, Jost Enninga, Jean-Christophe Olivo-Marin, Daniela Männel and Chiara Zurzolo
  Prions hijack tunnelling nanotubes for intercellular spread
  Nature Cell Biology, Volume 11, Number 3, March (2009)
- Alexandra Tibelius, Joachim Marhold, Hanswalter Zentgraf, Christoph E. Heilig, Heidemarie Neitzel, Bernard Ducommun, Anita Rauch, Anthony D. Ho, Jiri Bartek and Alwin Krämer
  Microcephalin and pericentrin regulate mitotic entry via centrosome-associated Chk1
  The Journal of Cell Biology. Vol. 185, No.7, 1149-1157 (2009)
- Miroslav Cervinka, Zuzana Cervinkova and Emil Rudolf
  The role of time-lapse fluorescent microscopy in the characterization of toxic effects in cell populations cultivated in vitro
  Toxicology in Vitro, Vol. 22, 1382-1386 (2008)
- Satoshi Fujita, Masahiro Ohshima and Hiroo Iwata
  Time-lapse observation of cell alignment on nanogrooved patterns
  J R Soc Interface, June 2009; 6: S269 - S277
- Anna Kawai, Yoko Nishinaka, Toshiyuki Arai, Kiichi Hirota, Hiroko Mori, Nobuyuki Endo, Takashi Miyoshi, Kouhei Yamashita and Masataka Sasada
  α-Phenyl-N-tert-butyl Nitrone Has Scavenging Activity Against Singlet Oxygen ($^1O_2$) and Attenuates $^1O_2$-Induced Neuronal Cell Death
  Journal of Pharmacological Sciences, Volume 108, 545-549 (2008)
- Takashi Miyoshi, Toshiyuki Arai, Mitsuru Nonogawa, Keisuke Makino, Hiroko Mori, Kouhei Yamashita and Masataka Sasada
  Anticancer Photodynamic and Non-photodynamic Effects of Pterin Derivatives on a Pancreatic Cancer Cell Line
  Journal of Pharmacological Sciences, Volume 107, 221-225 (2008)
- Sabrina Chia-Chin Lin, Jo-Hao Weng, Kimberly Lung, Jonathan Balakumar, Victor Slupski and Prue Talbot
  Analysis of Human Embryonic Stem Cell Behavior in Control and Experimental Conditions Using Time-Lapse Video Microscopy Endpoints
  Biology of Reproduction, July 2009; 81: 667

WARNING TO ENSURE CORRECT USAGE, READ THE CORRESPONDING MANUALS CAREFULLY BEFORE USING YOUR EQUIPMENT.

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