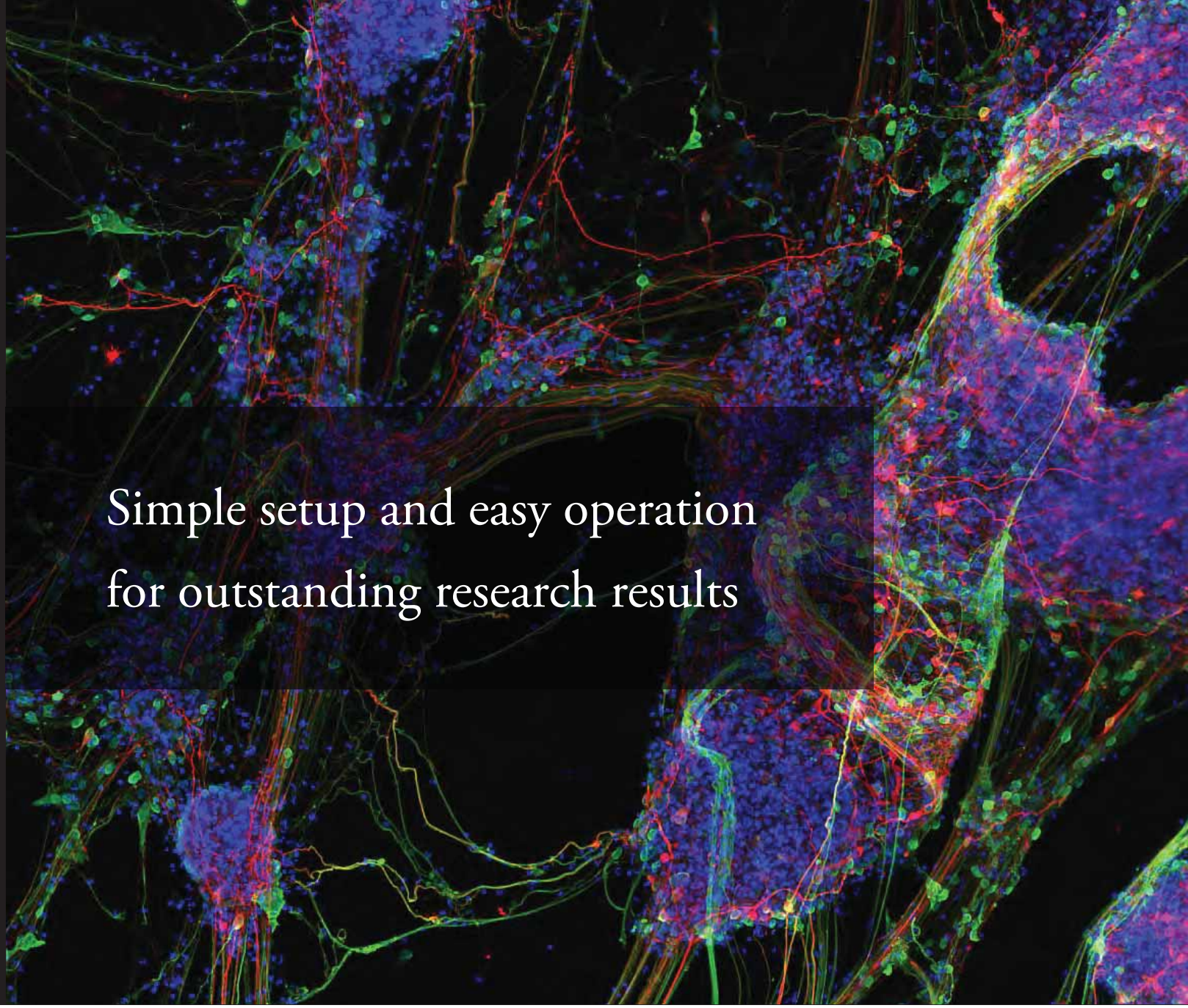
KEYENCE

# All-in-One Fluorescence Microscope

BZ-X Series

## Modular design expands as your research changes

## Automated High-Resolution Microscope for Life Science Research



# Simple setup and easy operation for outstanding research results

## Built-in Darkroom, Space Saving

A specimen enclosure is built into the body of the microscope, allowing users to perform fluorescence imaging even in a brightly-lit room
The compact design means the unit can be set up in any location for optimal testing efficiency

## Any User Can Easily Capture Images

No complicated configuration required
With a single click, any user can capture publication-quality images

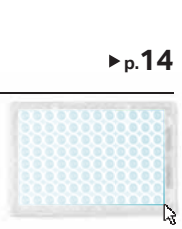
# Batch Analysis of Large Data Sets

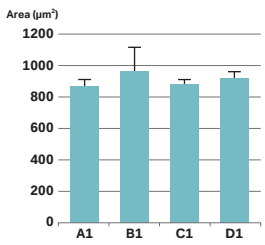
Capture and analyze in dramatically shorter time frames than with conventional microscopes for increased testing reliability and throughput

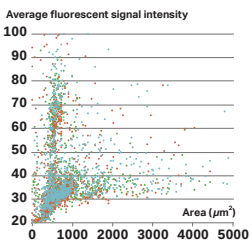
### Image cytometer module

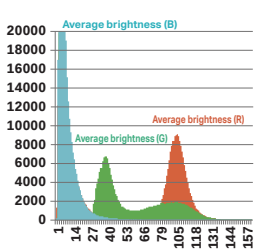
▸p.14

Copying settings enables bulk observation and analysis in one operation





All-in-One System

# Enhanced Core Performance

## No darkroom required

- High-contrast fluorescence imaging even in a brightly-lit room
- Enables an optimal working environment with space-saving design

## Full digital control

- All processes controlled within an easy-to-use software
- High reproducibility and user independent imaging
- Remote operation

## Publication-quality images

- Built-in high-sensitivity, high-resolution cooled monochrome camera
- Supports clear fluorescence, brightfield, and phase contrast observation over a range of samples


All-in-One Fluorescence Microscope
BZ-X Series

Expandable Design

# Adapts to Fit Your Research Needs

**Well scanning**

**Image cytometer**

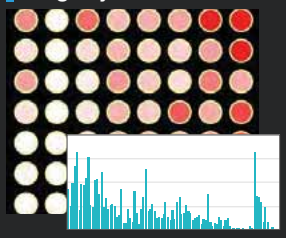
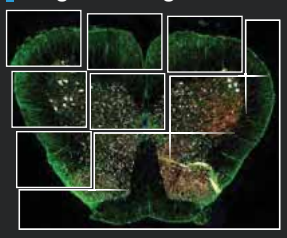
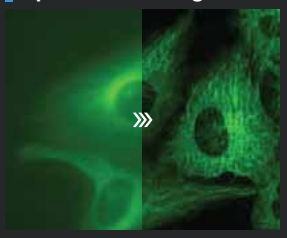


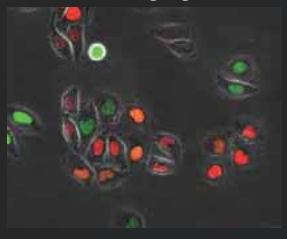
**Image stitching**



**Optical sectioning**

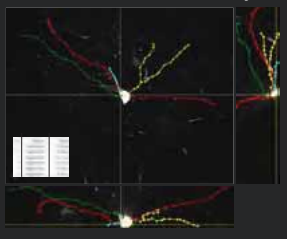


**Live cell imaging**

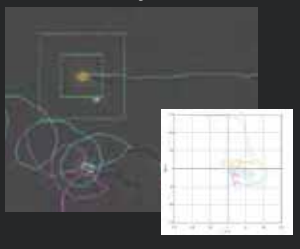


**Video capturing**

**3D measurement and analysis**



**Motion analysis**



**Built-in high-sensitivity cooled monochrome camera and high-intensity LED light source**

# Advanced Observation Delivers High-Resolution Images


Objective: BZ-PA40 Plan Apochromat 40×(Dry)

## Cooled CCD

Even when a CCD is not exposed to any light, dark current signals are generated and create unwanted noise in an image. This noise is largely temperature-dependent, increasing as a CCD gets warmer. The Peltier-cooled CCD in the BZ-X Series is cooled to 25°C 45°F below the ambient temperature to achieve high-sensitivity imaging with little noise.

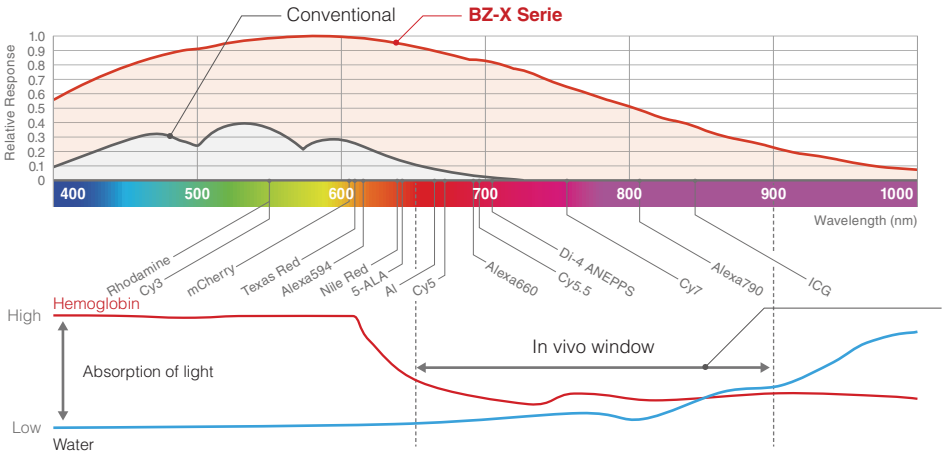
# Bright, High-definition Imaging

## Low noise, high sensitivity

The cooled monochrome camera provides clear images that combine high sensitivity and low noise. This enables clear fluorescence imaging even with low excitation light, minimizing both photobleaching and damage to cells sensitive to phototoxicity.

## High sensitivity across short and long wavelengths

The camera is also able to image dyes such as Cy7 in the near-infrared range, allowing for observation of cells located even in deep tissue layers. Additionally, it uses a high-intensity LED as the fluorescence light source for its broad wavelength range from UV through to IR. It supports a range of fluorescence pigments without adding a light source, simply by changing filters.




The 650 to 900 nm wavelength range is referred to as the “in vivo window.” With low levels of autofluorescence and light scattering in this range, long-wavelength fluorescent dyes are ideal for visualizing deep regions of living tissue.

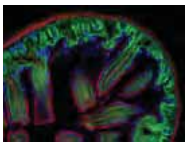
## One-click monochrome/color switching camera

Switching between color and monochrome imaging modes can be easily performed with just one click. An electronic liquid crystal filter enables high-definition 3CCD imaging with superior color reproducibility. This creates ideal conditions for brightfield applications such as H&E, DAB, and similar dyes.

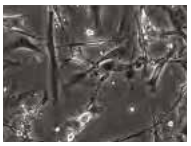
## High versatility across various samples

The system supports fluorescence, brightfield, and phase contrast imaging. Users can observe various specimens in different vessel types, enabling versatility across a wide range of experiments.

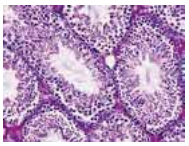
Fluorescence



Phase contrast



Brightfield

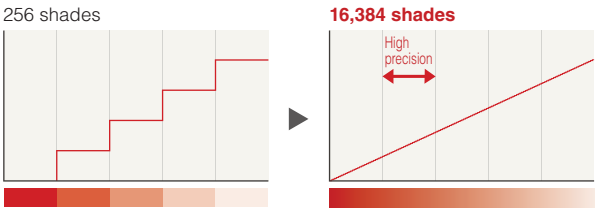


# Accurate Detection for Reliable Data

Unlike color cameras, the CCD element does not use color filters. This eliminates variations in light quantities received on the CCD due to the fluorescence color. This allows for accurate quantification of fluorescence intensity, which is important for evaluating properties such as protein weights.

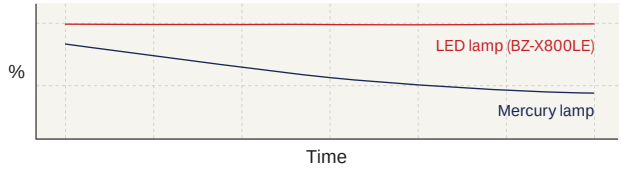
## 14-bit, high-level gradation

Data capturing with 16,384 gradations allows for accurate measurement of expression levels and precise quantification.




## Stable light intensity over a long period

The BZ-X800LE has a fluorescence light source that incorporates a long-life LED lamp. Stable light intensity is secured both in the short term and in the long term, and quantitative comparison is possible even for data that was captured on different days.



**Large motorized stage equipped to observe an entire well plate**

# Easy Operation for Dramatically Improved Observation


### Anti-vibration construction

The BZ-X Series uses a floating stage structure with anti-vibration dampers to stabilize high-precision imaging. High magnification capture, image stitching, and observation of cultured cells in liquid media can be performed anywhere, unaffected by vibration.

### Variety of containers supported

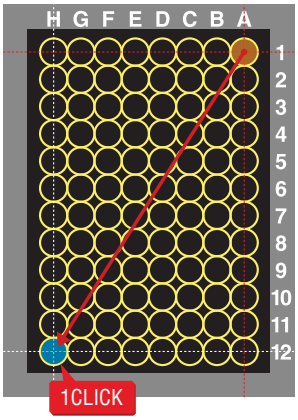
Sample holders for slides, dishes, flasks, and multi-well plates are included. Sample holders for special containers are also available upon request.

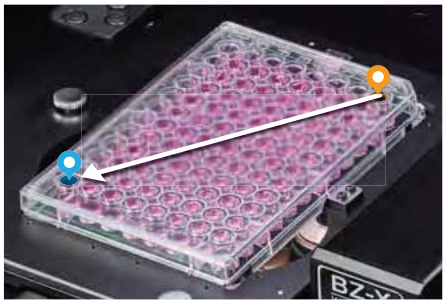



# Easy Navigation

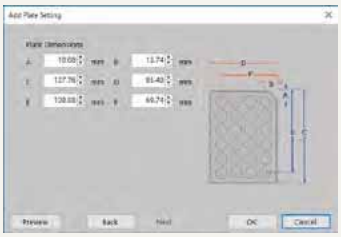
## Stage view

Users simply click a point on the stage map to instantly navigate to that location on the sample. Even with large well plates, users can find regions of interest quickly and easily.



The map and motorized stage are linked with high precision.
The encoded stage moves instantly to the clicked location.



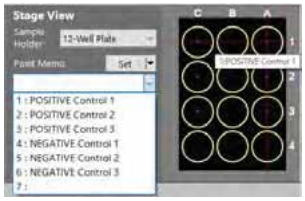
Advanced plates supported

Plate customisation function

Create plate maps for use in experimental systems that use advanced plates, as well as for conventional plates in order to greatly improve the efficiency of daily observation work.

## Point memo

Record coordinates of regions of interest. Click the point memo to instantly return to that location.




## Six-mount electronic lens revolver

Both field of view and focus can be maintained even when changing magnification for easy observation.

**Any combination**

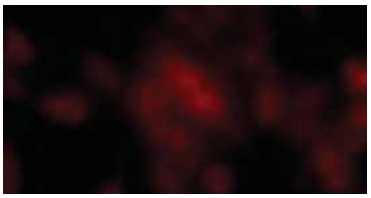
Magnification 2–100× | Oil-immersion lenses | Dry lenses | Phase contrast lenses

# Fast and Easy Focusing

## High-speed auto focus

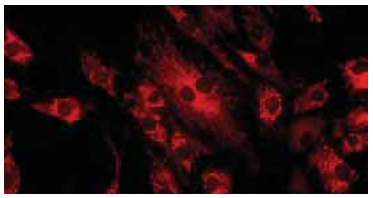
With a single click, instantly focus on any sample in fluorescence, brightfield, or phase contrast at any magnification. The rapid auto focus uses a high-sensitivity partial scan mode in the Z axis.

One-click auto focus



High-sensitivity partial scan for high-speed processing

Accurate focus



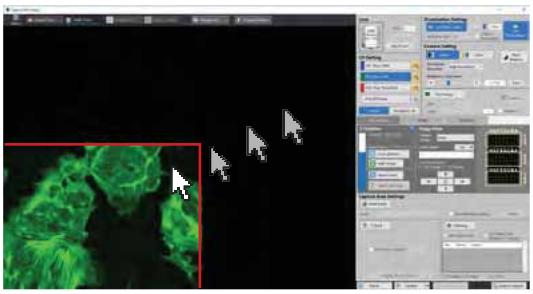
### High-sensitivity partial scan

By combining the CCD's partial reading and binning processing, this mode enables the display of images with even higher sensitivity. Weak fluorescence signals normally require a long exposure time, but this mode makes it possible to read them at high speed for rapid focusing. The BZ-X Series uses a dedicated focus control motor for high-precision control in the Z axis for accurate, user-independent auto focus.

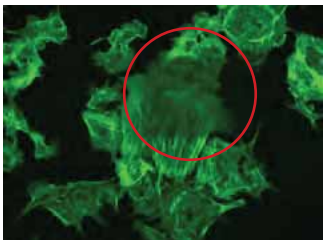
# High-Efficiency Imaging

## Low photobleach mode

When changing the focus or field of view, the excitation light is only pulsed long enough to display an image. The excitation light is then turned off until another adjustment is made, minimizing photobleaching and prolonging the life of the specimen.

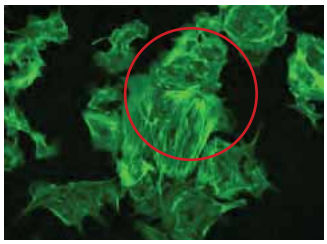


Conventional



Photobleaching during high-magnification observation leads to sample damage with irregularities in brightness

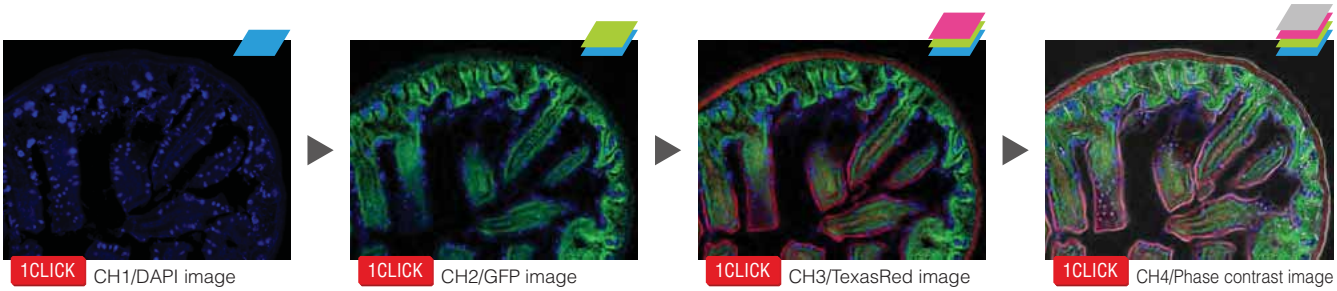
**Low photobleach mode**

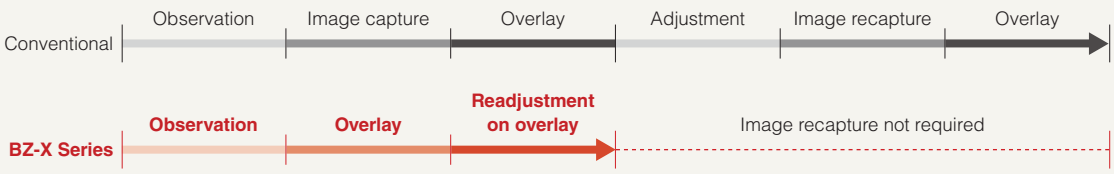


Photobleaching is minimized, resulting in uniform brightness

## Real-time overlay

Capture settings such as focus and exposure time on an overlaid image can be viewed and adjusted prior to image capture.
On a conventional system, a multi-channel overlay would need to be captured, adjusted, and recaptured to obtain the desired result.
The BZ-X Series saves time by providing a real-time overlay prior to image capture.

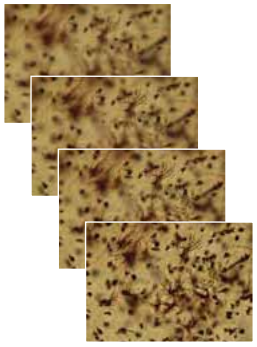


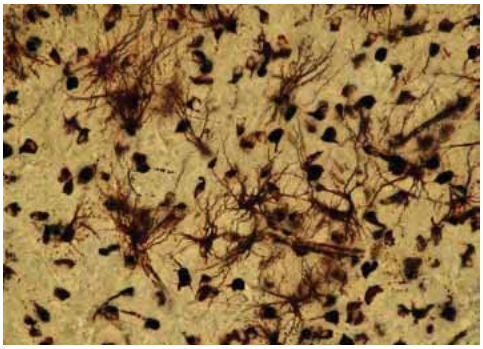

## Quick full focus

With a single click, the system automatically scans the height of the sample and creates a fully-focused composite image in real-time. This greatly reduces the time and effort required to interpret several partially-focused images of a thick target.

Rat brain, Golgi staining
Sample courtesy of Dr. Seiji Otani, Cell Technology Laboratory



One-click, automatic scanning

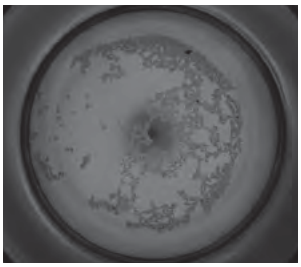


Fully-focused image

# Capture Condition Reproducibility

### Load capture settings

Capture conditions such as the filter settings, magnification, exposure time, and capture position can be read from previous images for easy reproducibility. Any user can capture images using the same conditions, eliminating variability between operators. This also allows for accurate observation of changes over time, with a higher degree of repeatability.



Live cell capture

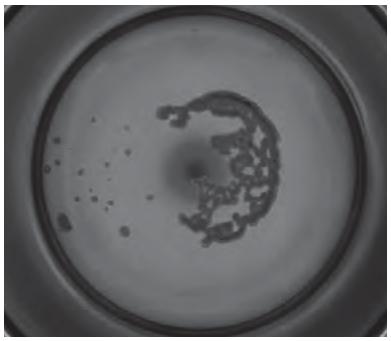
Return to incubator


Recapture

Conventional

Manual location search → Manual condition reproduction → Less accurate image capture

Users must keep track of what settings were used, such as the location coordinates and exposure time, and then manually reproduce them in future captures. This takes time and decreases accuracy.



**BZ-X Series**

**Load setting** → **Accurate, fast capture** → **High reproducibility, saves time**

Every setting such as location coordinates, exposure time, imaging channel, and magnification are automatically saved with each image. These conditions can then be loaded directly from an image, saving time and ensuring experiment accuracy.

# Enhance contrast of unstained transparent specimens

### Oblique illumination

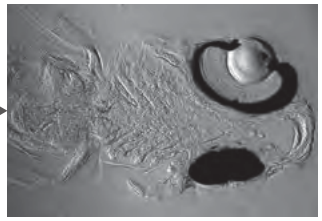
Observe images similar to those obtained by using differential interference contrast (DIC), but without any additional lenses, prisms, or other hardware. Unlike DIC, this technique can be performed through plastic containers, making it suitable for observing ova and other clear specimens.

Conventional

Zebrafish

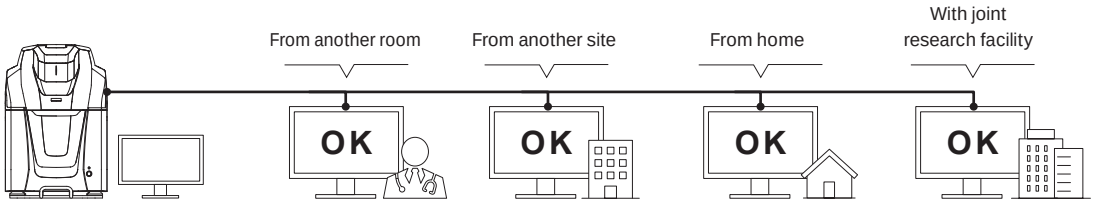
1CLICK

**Oblique illumination**



# Fully Motorized to Support Remote Control

All processes from imaging to analysis are performed with a PC, allowing remote control via a network. Observation and analysis can be performed while holding discussions with off-site joint research facilities. Among a host of possible uses, the microscope can be utilized in laboratories that cannot be accessed frequently due to a high biosafety level, and as a tool to reduce crowding in laboratories.



# Enhanced Observation and Analysis

## Expandable to support diverse applications while maintaining ease-of-use

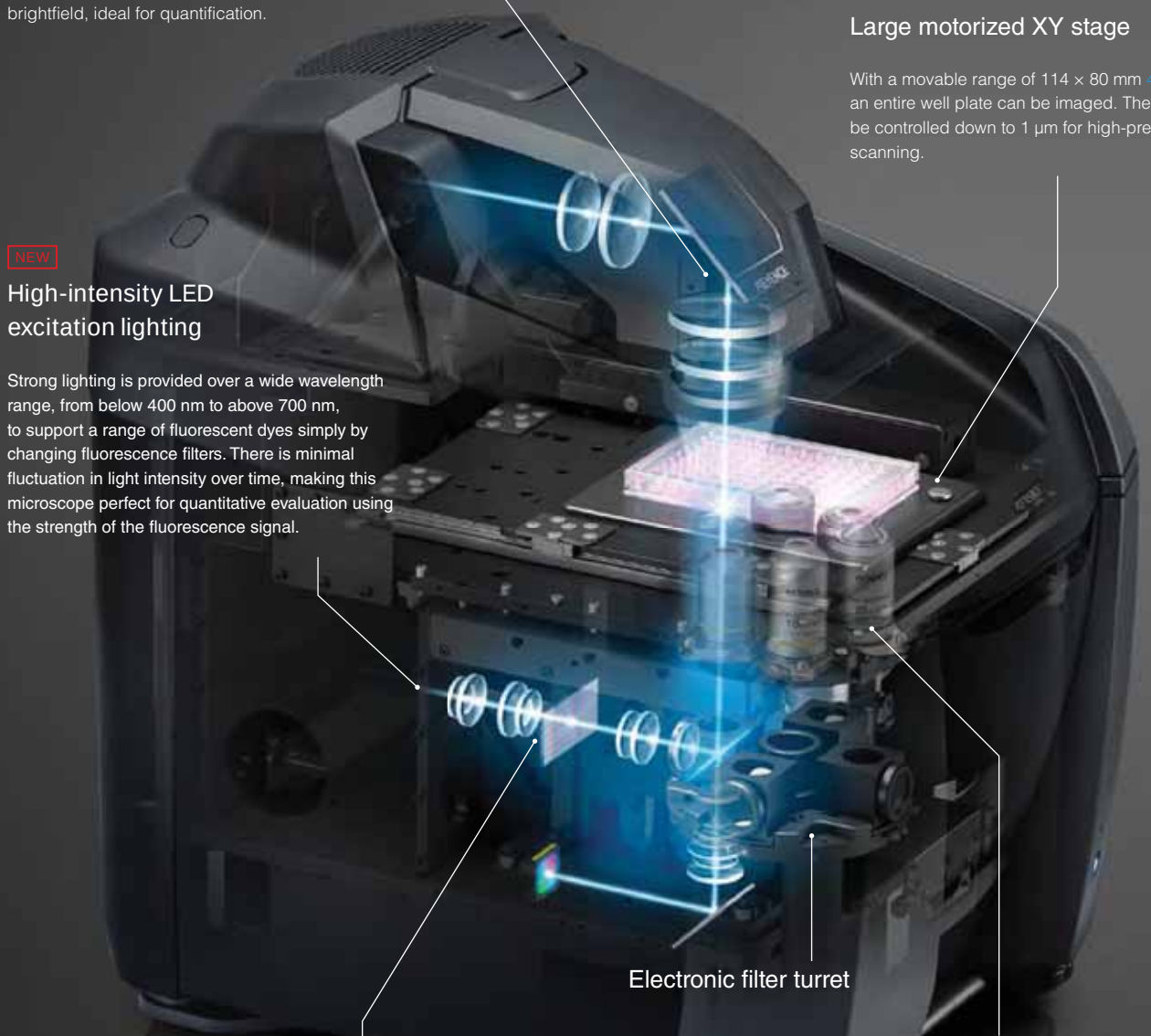
The built-in configuration includes all of the hardware required for the optional modules. Upgrades are easy and fast for on-demand expandability. The software interface remains the same as modules are added, allowing users to easily operate the system after upgrading.

### LED transmitted illumination

The long-lifetime LED has little to no change in color temperature over time. This allows for accurate hue representation in brightfield, ideal for quantification.

### Large motorized XY stage

With a movable range of 114 × 80 mm 4.49" × 3.15", an entire well plate can be imaged. The stage can be controlled down to 1 µm for high-precision scanning.



NEW

### High-intensity LED excitation lighting

Strong lighting is provided over a wide wavelength range, from below 400 nm to above 700 nm, to support a range of fluorescent dyes simply by changing fluorescence filters. There is minimal fluctuation in light intensity over time, making this microscope perfect for quantitative evaluation using the strength of the fluorescence signal.

### Electronic filter turret

### Electronic projection element

With a single click, the electronic projection element creates a structured illumination pattern for optical sectioning capture. As opposed to a mechanical component, the electronic element enables high-speed and more customizable projection patterns.

### Six-mount electronic lens revolver

Lenses are positioned to facilitate stable, continuous capture of various points and conditions. With phase contrast and oil-immersion lenses, applications ranging from cultured cells to sectioned tissue can be imaged on a single platform. The lens can be controlled down to a 0.1 µm step size in the Z axis for high-precision 3D analysis.

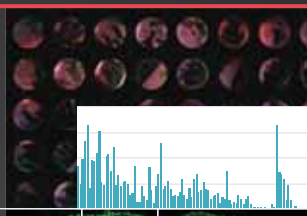
# Observation and Capture Modules

BZ-H4XI

## Image Cytometer Module

Batch capture and analysis of large amounts of data, including well plates.

▶ p.14

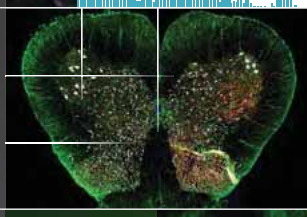


BZ-H4XD

## Advanced Observation Module

High-precision image stitching and Z-stacking for multilayer capture.

▶ p.16

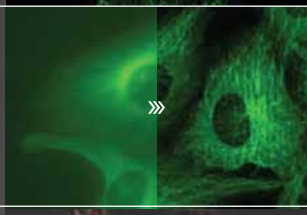


BZ-H4XF

## Sectioning Module

Optical sectioning capture with structured illumination.

▶ p.20

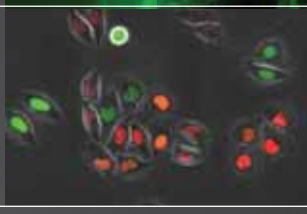


BZ-H4XT

## Time-lapse Module

Automated capture at user-specified intervals for video and time-series measurements.

▶ p.24



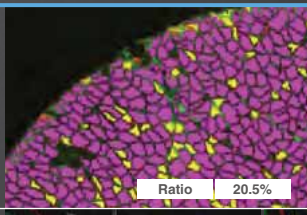
# Analysis Applications

BZ-H4C/BZ-H4CM

## Hybrid and Macro Cell Count

KEYENCE's original algorithm enables accurate quantification of image data.

▶ p.26

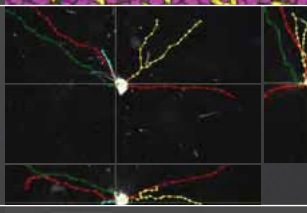



BZ-H4R

## 3D Application

Creation of 3D images from Z-stack data. 3D measurement of localization and configuration available.

▶ p.30

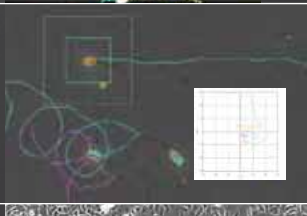


BZ-H4K

## Motion Analysis Application

Tracking of user-specified targets to measure travel range, speed, and coordinate positions.

▶ p.32

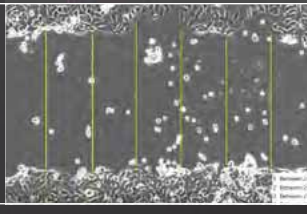


BZ-H4M

## Measurement Application

Manual 2D measurements, including area.

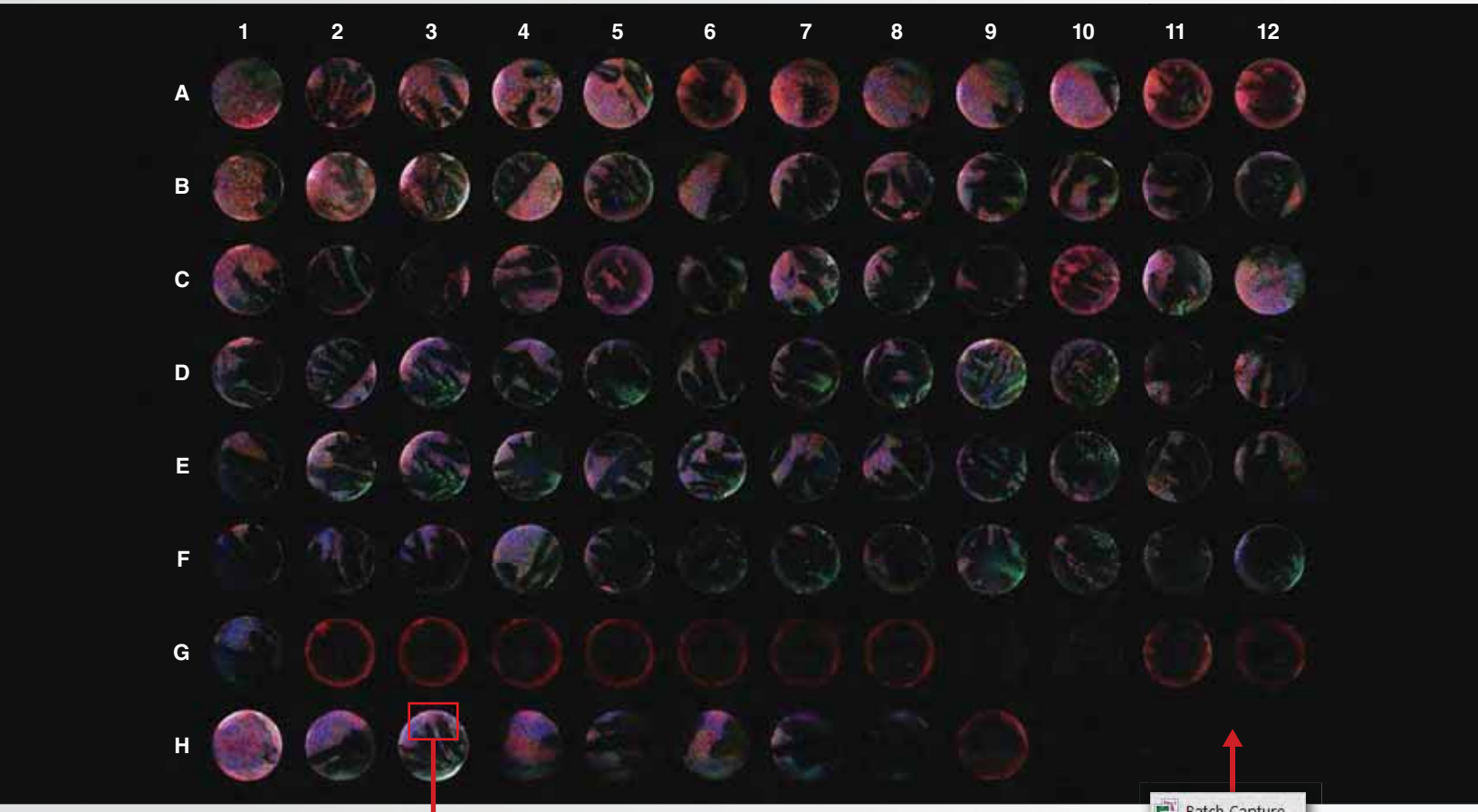
▶ p.33



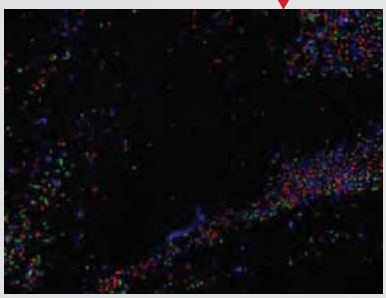
## Image Cytometer Module

# High Throughput for Capture and Analysis

Capture settings in one location can instantly be applied to all fields of view on a well plate. Users can select any or all wells to be scanned with uniform conditions for high reproducibility of data. This work flow can be completed in just three simple steps. The system will then automatically execute the capture without any additional user configuration.



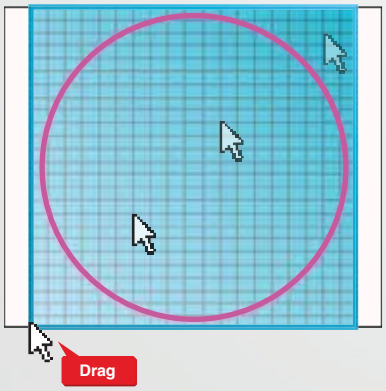

**STEP 1**
Set capture conditions



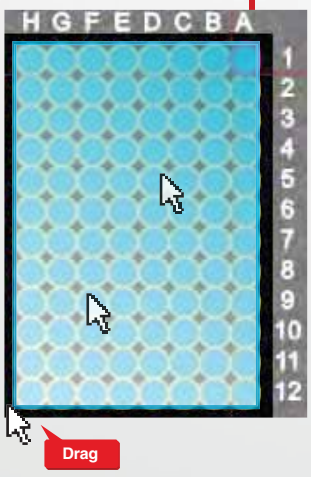
| | |
|---|---|
| Lens magnification | Exposure time |
| Channel | Camera settings |
| Z-stack | Sectioning |

etc.

**STEP 2**
Click and drag to specify the range of capture within a well



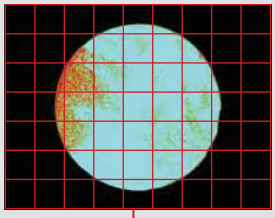

**STEP 3**
Click and drag to specify wells to capture

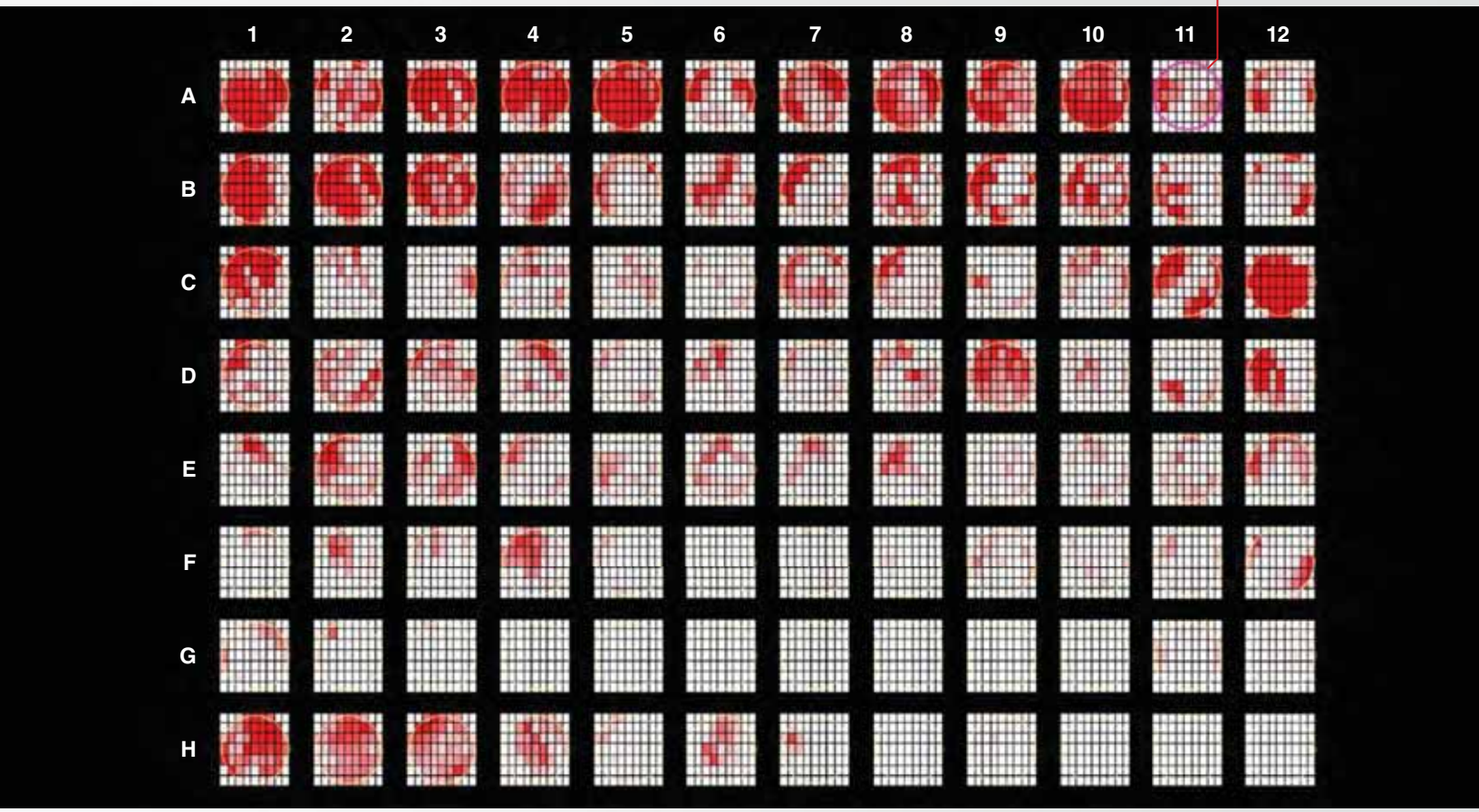


## Image Cytometer Analysis

# Accurate, High-Content Analysis with High-Resolution Images

Set analysis conditions for a single image and apply to all data points automatically. This saves time and reduces variability from one image to the next. The BZ-X Series's advanced optics capture high-resolution images, resulting in highly precise data acquisition.






▲ **Heatmap function** Gradated display visually represents different measurement values between fields of view and wells

### Statistical analysis

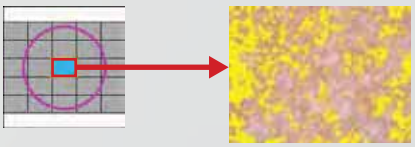
This enables the creation of graphs for each measured item, such as sample counts, area, and light intensity. As well as graphs by well and by field of view, each field of view and measured value can be combined to create graphs covering the whole plate as a target.

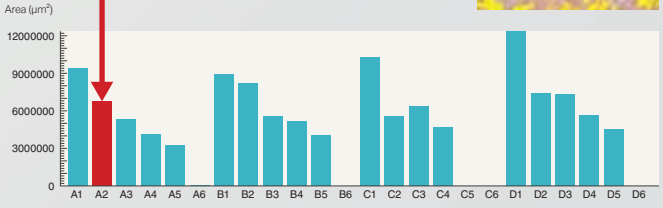
Stitched image of all wells

Heat map

Click any well to highlight the related data.

Easily check image data at any location in a well

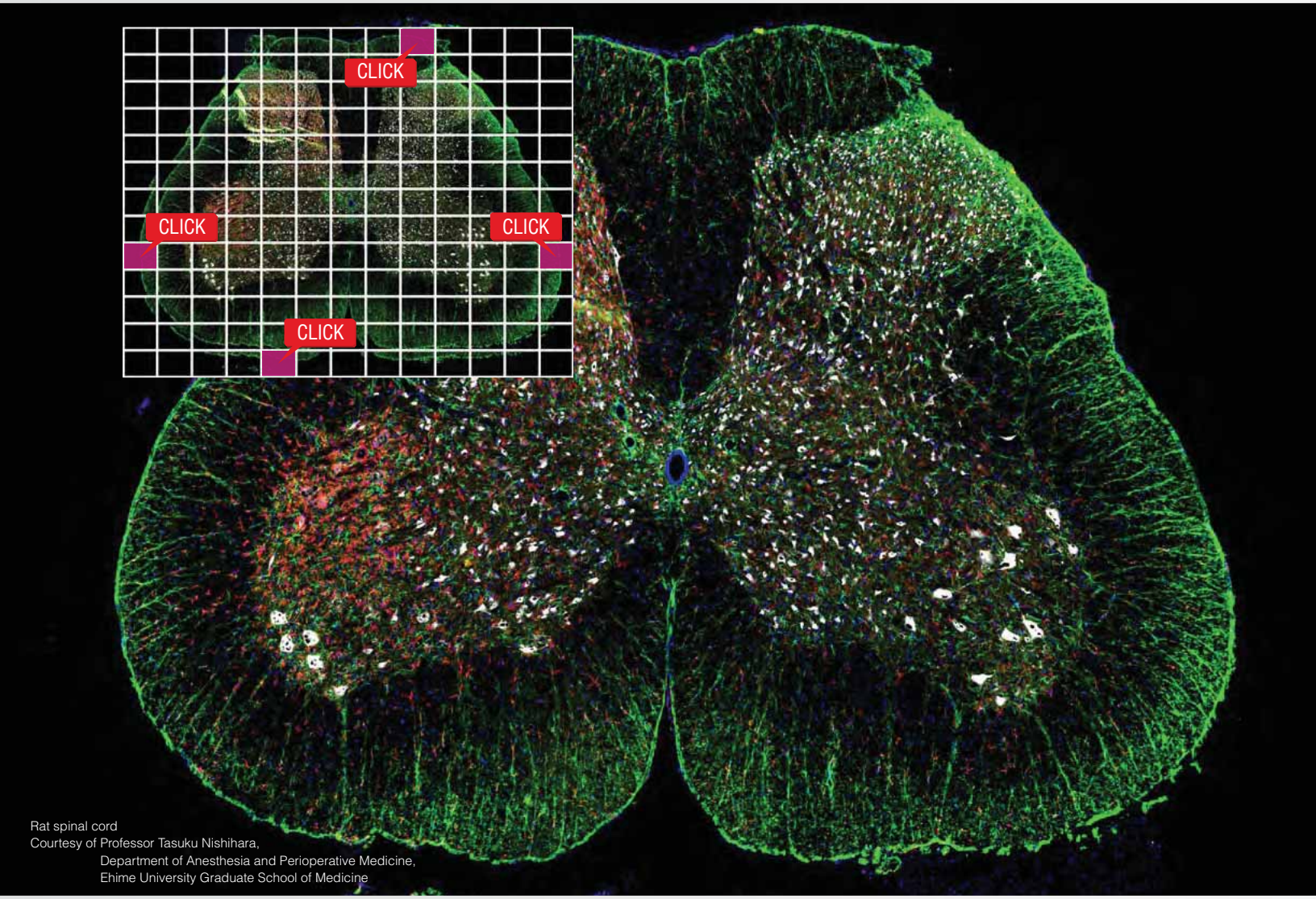




## Image Stitching

# High-Speed Capture of High-Resolution, Wide-Area Images

Viewing a specimen at high-magnification often requires an expansion of viewing area beyond a single field of view. Image stitching allows the user to easily capture an entire specimen at high-magnification, and seamlessly create a single high-resolution image.
Up to 50,000 x 50,000 pixels can be rapidly joined together without stitch lines or brightness variations. A large quantity of images can be captured at a speed that is seven times faster than that of conventional methods.




Rat spinal cord
Courtesy of Professor Tasuku Nishihara,
Department of Anesthesia and Perioperative Medicine,
Ehime University Graduate School of Medicine

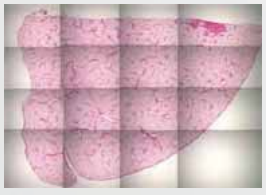
### Automatic specimen capture

Capture an entire specimen automatically by registering the coordinates of its outermost positions.

### High precision shade correction

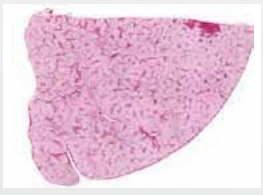
Uneven light intensity caused by lens aberration or non-uniform light sources appear as seams in the stitched image. This results in an unnatural appearance and affects the accuracy of quantification.
The BZ-X Series eliminates uneven light intensity with its high-precision shade correction algorithm in order to create seamless, high-resolution images.

Conventional stitched image



Uneven light intensity causes stitch lines

**BZ-X Series stitched image**

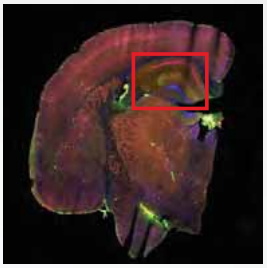


Shade correction eliminates stitch lines

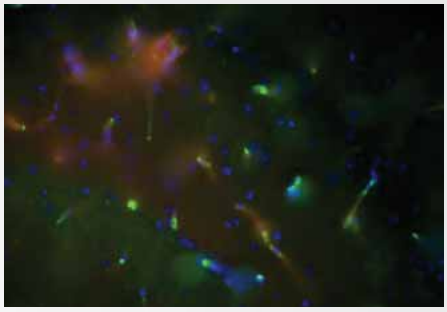
## Full-focus Image Stitching

# Fully-Focused Images of Thick Samples

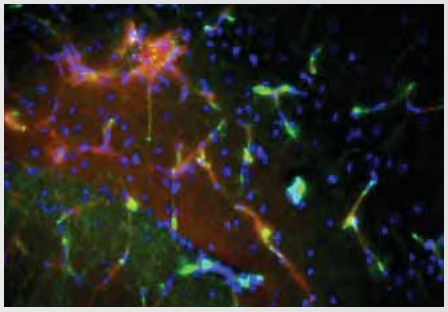
The automated stage captures a Z-stack for each individual field-of-view being stitched. This allows for a fully-focused wide-area image to be obtained for thick or dense samples.



Conventional



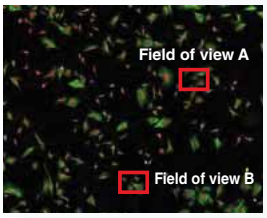
BZ-X Series



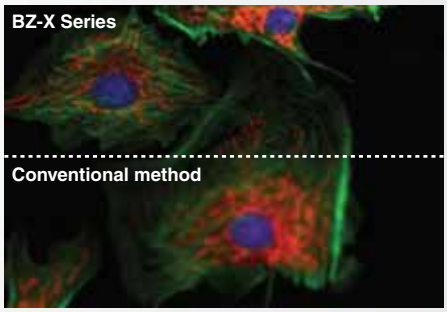
## Auto-focus Image Stitching

# Rapidly Focus Each Field of View

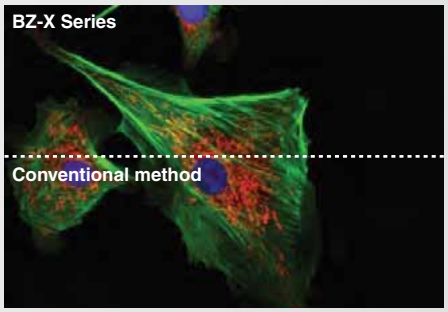
Each field-of-view is auto-focused prior to image capture. Optimally-focused stitched images of samples with height variations, such as an unevenly sliced tissue section, can be captured without user input.




Field of view A

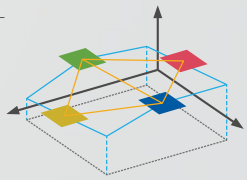



Field of view B




## Edge-focus Image Stitching

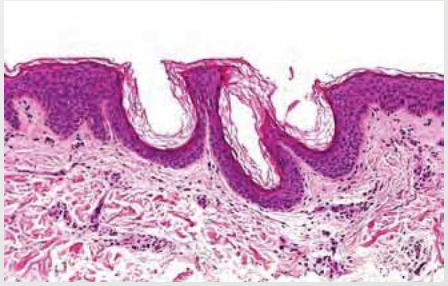
# Set Z Point Positions for Fast, Focused Stitching



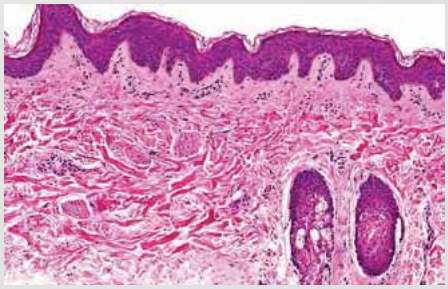
Set the focal plane for a few fields of view and then execute a rapid, single layer stitch with fewer captures.
The Z axis will change gradually as the sample is scanned for rapid image stitching and minimal photobleaching.

Field of view A  Field of view B

Field of view A



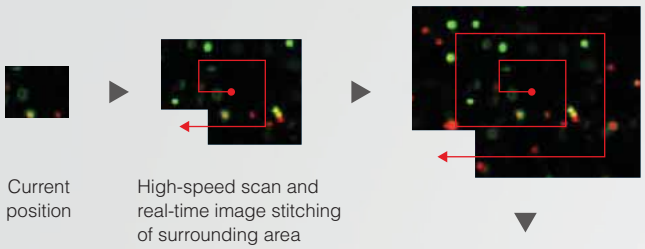
Field of view B



## Navigation

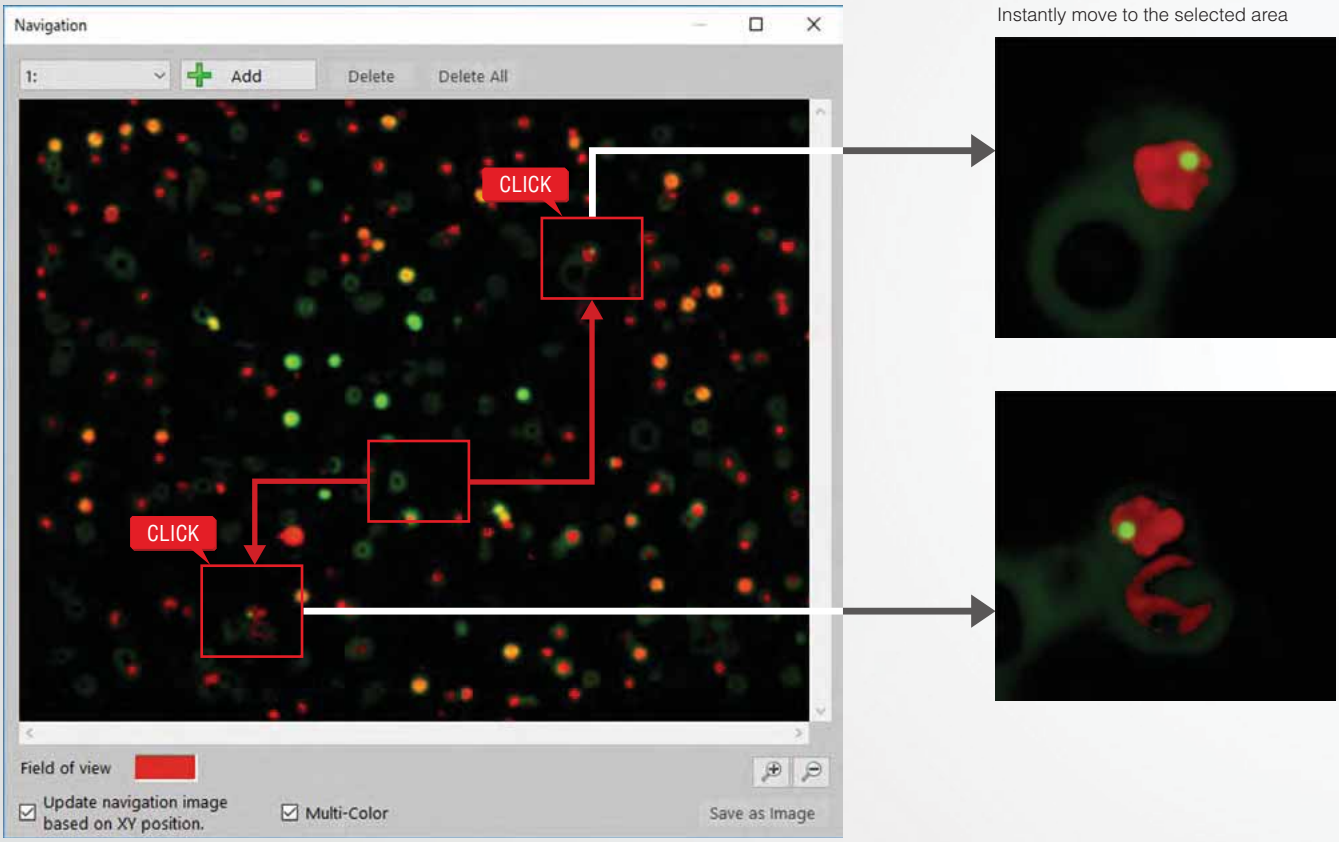
# Easily Locate Areas of Interest

With a single click, adjacent fields-of-view are rapidly stitched together to create a navigation image of the entire sample. Clicking anywhere on the navigation screen will immediately move the stage to that location. The current field-of-view is always displayed on the navigation image, so users never lose sight of the relative viewing position, even at high magnifications.



Current position

High-speed scan and real-time image stitching of surrounding area

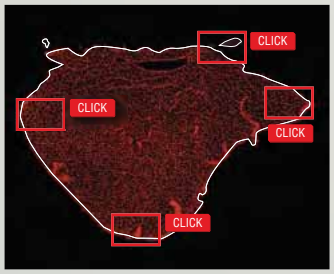



Micronucleus testing (genotoxicity test)

### Image stitching made simple

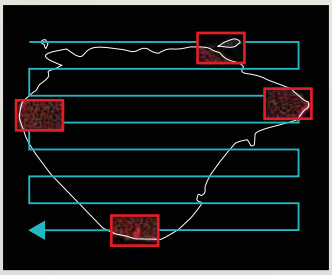
STEP 1

While viewing the entire image of the specimen on the navigation screen, click the four points on the outside edge of the specimen to register their coordinates.




STEP 2

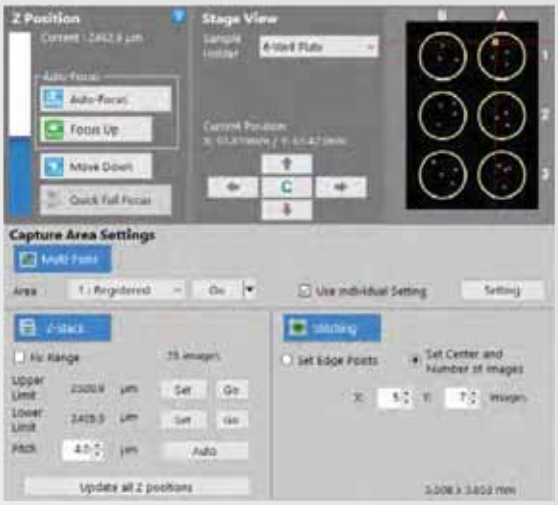
The stitched image is then captured without missing any part of the specimen. This eliminates the time and effort spent recapturing images due to some areas missing from the stitched image.



## Multi-point & Multi-condition Capture

# Efficient Image Capture of Multiple Specimens

Up to 999 coordinate points can be recorded. A variety of capture conditions such as magnification, exposure time, Z-stack settings, and image stitching can be set individually for each point. As with normal observation, simply click "Set" to register capture conditions. Multiple points of data can be obtained at the same time, and this function is also useful when performing repeated evaluations of the same location on multiple specimens, such as with sequential sections and well plates.

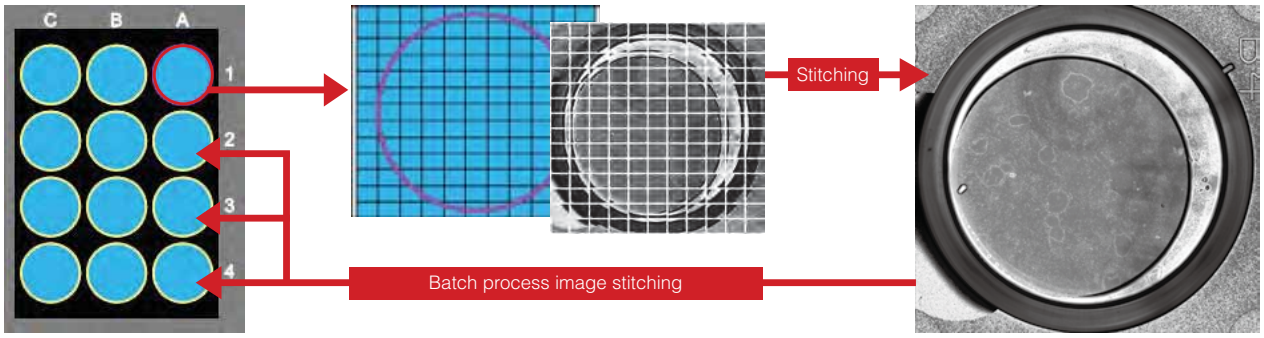



## Batch Process Image Stitching

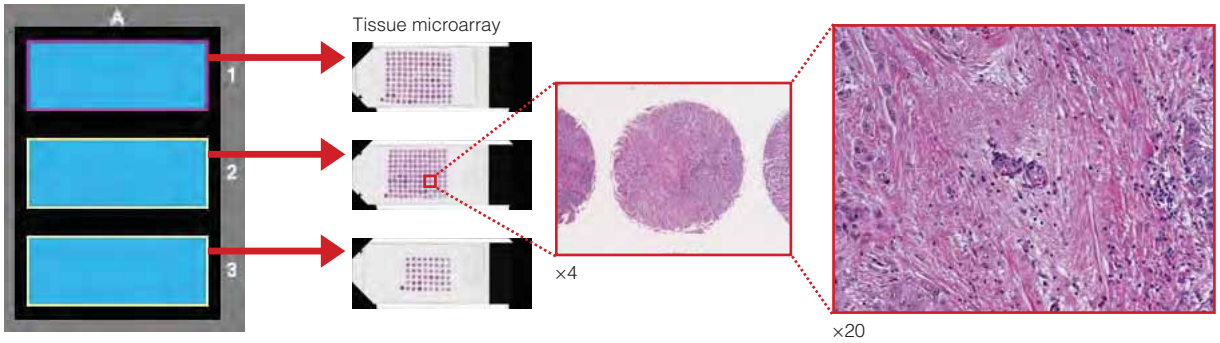
**BZ-H4XD × BZ-H4XI × BZ-H4C**

# Stitch Multiple Samples

Automatically carry out image stitch processing for multiple wells using macros. Acquire high-quality images without compromising on lens magnification or image resolution.



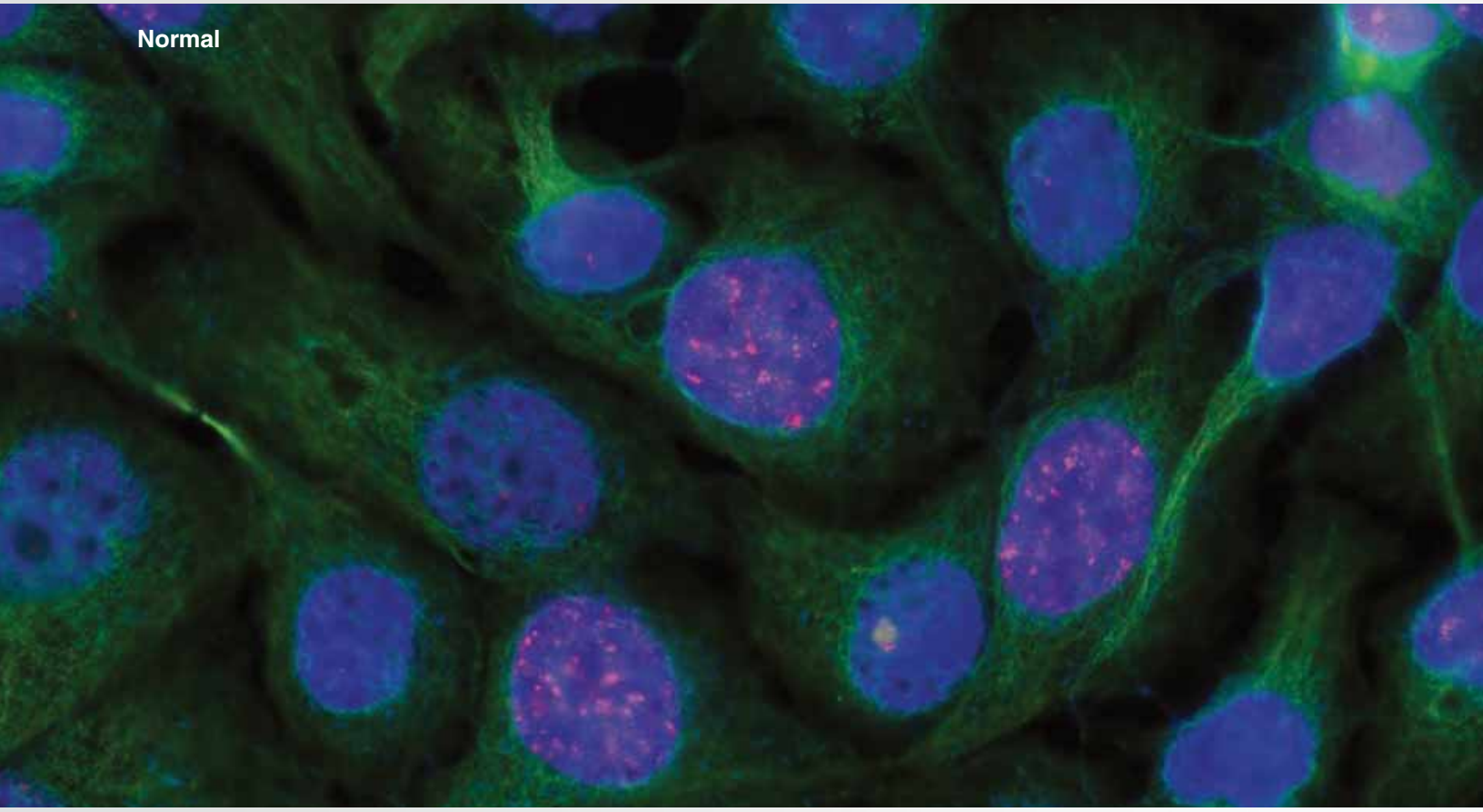

**Whole slide scans** The BZ-X800LE Wide Image Viewer saves uncompressed images with the highest possible resolution, allowing users to observe fine details of large samples.



## Optical Sectioning

# Capture Clear Images Without Fluorescence Blurring

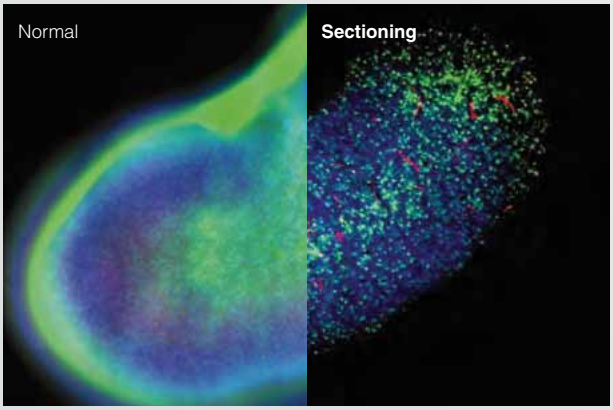
Easily capture high-definition images without the blurring caused by out-of-focus signals. The unique optical sectioning technology in the BZ-X Series uses an electronic projection element for structured illumination. Operation is simple and intuitive, allowing even first-time users to capture publication-quality images in seconds.



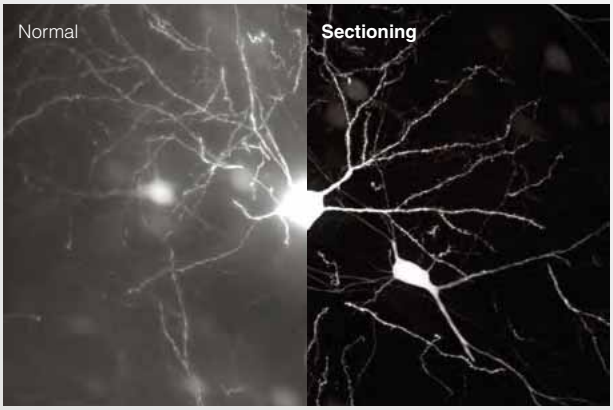

### Clear capture of thick specimens

Optical sectioning accurately detects fluorescence signals in the desired focal plane, providing clear optical slices of thick samples. A wide range of samples, including animal cells, plant cells, and cultured tissue can be easily observed.

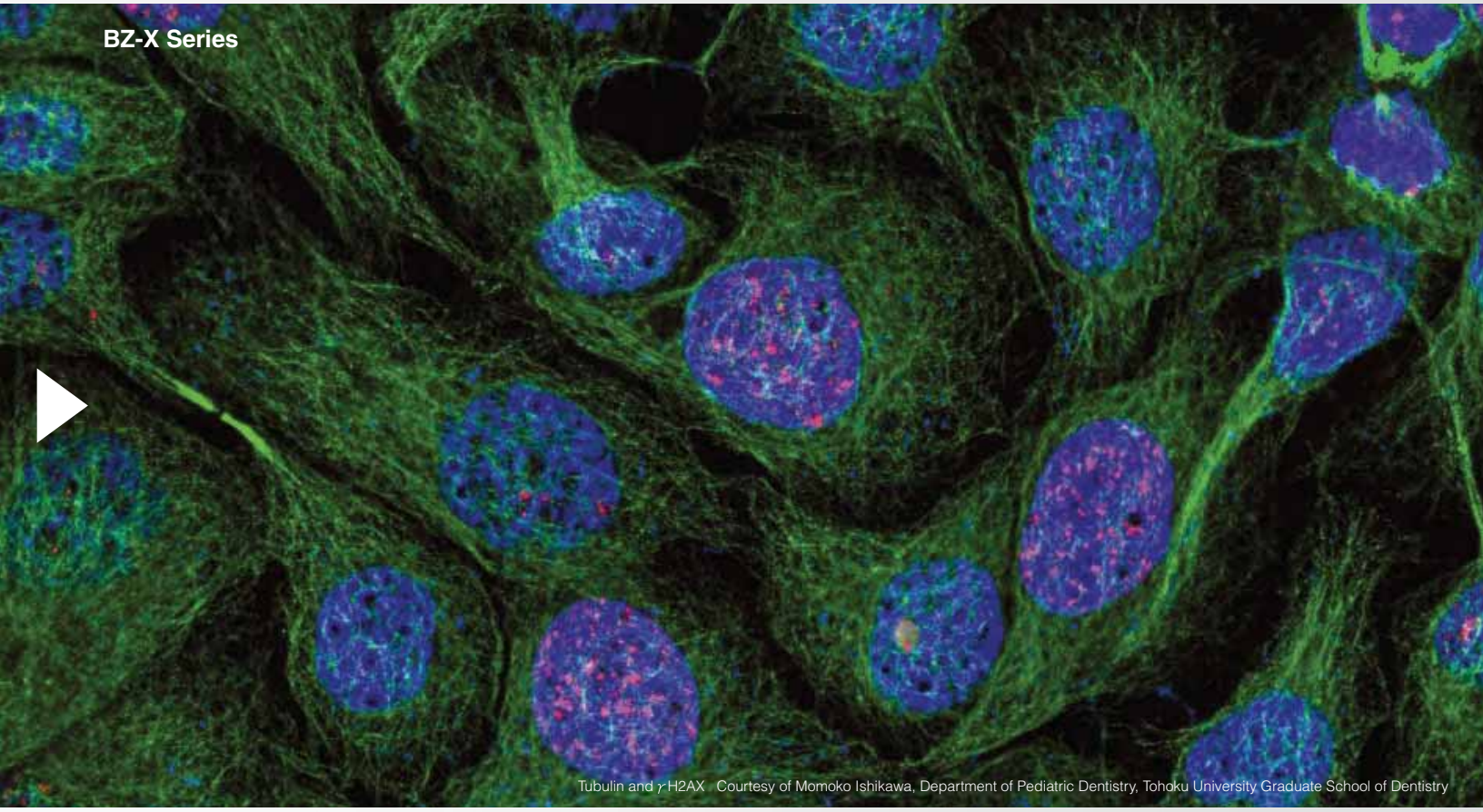
Kidney, whole mount




Mouse cranial nerves (transparent samples)



Take a look at the effects of optical sectioning ▶

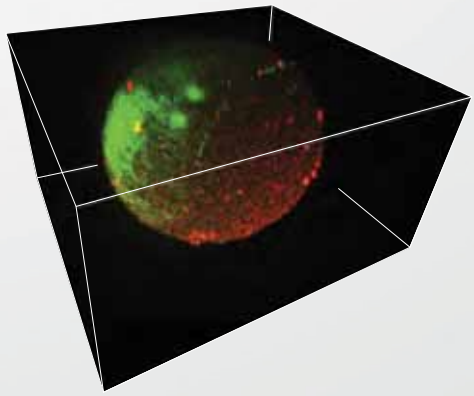



Tubulin and γH2AX  Courtesy of Momoko Ishikawa, Department of Pediatric Dentistry, Tohoku University Graduate School of Dentistry

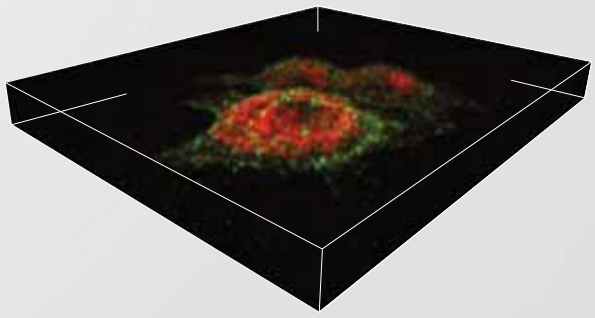
## 3D localization analysis

Optical sectioning provides high-accuracy, cross-sectional images without fluorescence blurring from other focal planes. Clear Z-stacks can then be transformed into realistic 3D renderings, allowing for accurate localization analysis.

Ascidiacea egg



HEK293 cell



Courtesy of Assistant Professor Taku Uchida, Graduate Student Tsuyoshi Takeishi, Department of Neuroscience, Section of Integrative Physiology, Faculty of Medicine, Graduate School of Medicine, University of Miyazaki

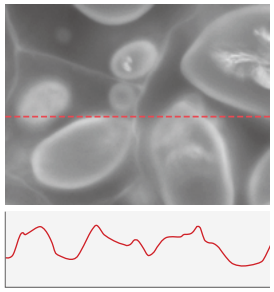
## Sectioning Algorithm

# High-Precision Optical Sectioning Using White Light

The electronic projection element enables a high-speed structured illumination scan. When compared to the effects of lasers, the white light source minimizes damage to the specimen. The use of white light also provides the ability to image over a wide wavelength range, delivering high-precision optically sectioned images.

### Normal image

Thick specimens cannot be captured with conventional widefield microscopes due to scattered light in the Z plane. This fluorescence blurring obscures true signals in the focal plane of interest.

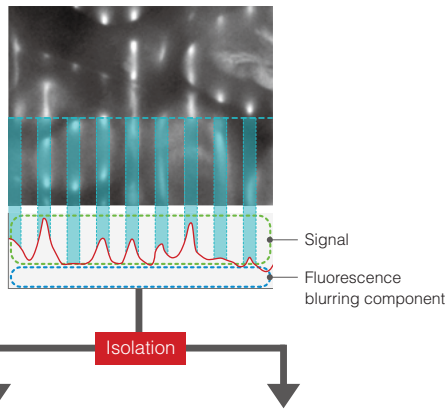


Brightness graph

### BZ-X sectioning

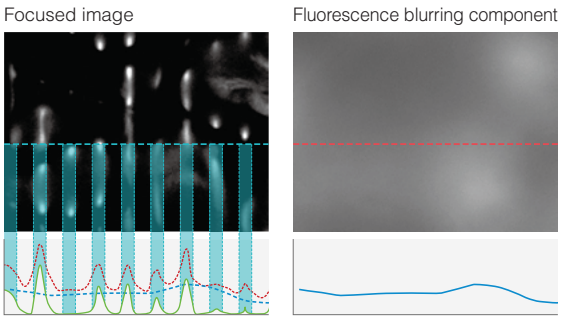
#### STEP 1: Pattern projection

The light passes through the electronic projection element and a structured pattern is projected onto the desired focal plane. Only signals within this focal plane are illuminated by the excitation light.



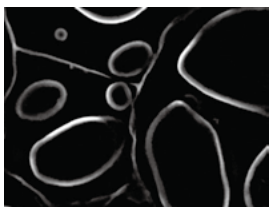

#### STEP 2: Scan and capture

Multiple images are captured while the illumination pattern scans across the sample. Since the brightness of scattered signals does not change significantly as the pattern moves, the fluorescence blurring can be extracted and eliminated.




#### STEP 3: Sectioning image

The fluorescence blurring is eliminated from the multiple images captured. These images are then automatically combined to produce a clear optical section.



# Benefits of Optical Sectioning

## Electronic projection element

The electronic component provides a more rapid, flexible excitation light configuration than a mechanical slit.

**POINT 1**
Optimal pattern automatically determined based on magnification.

**POINT 2**
Sectioning is optimized with a single click. No complex configuration or special skills needed.

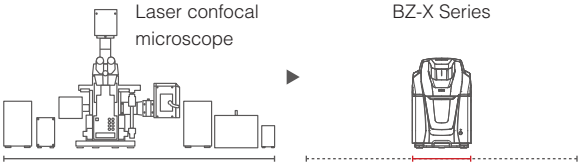
**POINT 3**
Pattern width and structure can be easily changed. A 2D pinhole pattern can be used for higher resolution capture.


1D slit (×40) 1D slit (×20) 2D pinhole (×20)

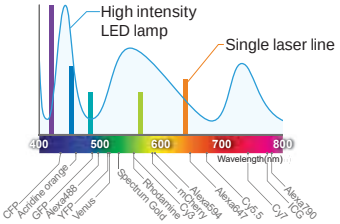
## White light source

Easy for any user to capture high-resolution images, without damaging lasers.

**POINT 1**
Simple, compact setup.

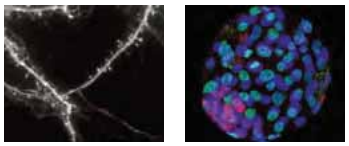



**POINT 2**
Simply change the filter to image any wavelength from UV to IR instead of dedicated laser lines.



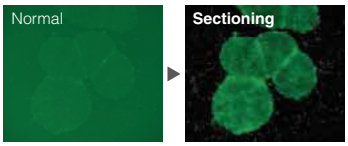

**POINT 3**
High-sensitivity detection using a monochrome cooled CCD reduces sample damage and photobleaching.

Spine (×100) Mouse embryo



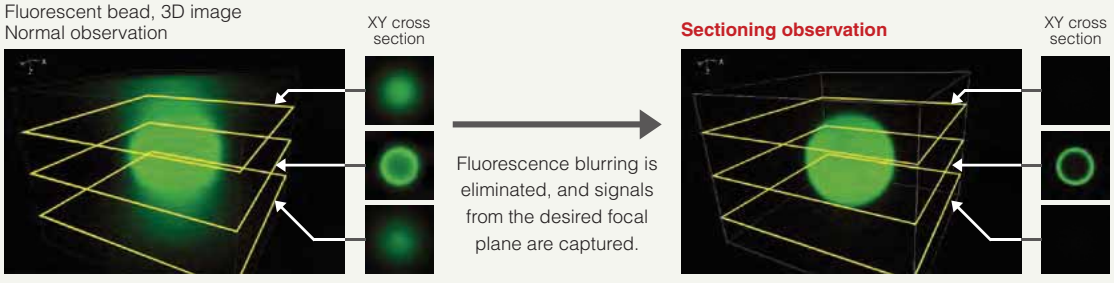
**POINT 4**
Capture images in any container, including plastic-bottom multi-well plates. No complex configuration required.

T-iPS cells in plastic dish




Courtesy of Assistant Professor Kyoko Masuda, Hiroshi Kawamoto Laboratory, Institute for Frontier Medical Sciences, Kyoto University

# More Accurate 3D Analysis Using Sectioning



## Time-lapse

# Temperature and $CO_2$ Regulation for Live-Cell Imaging

Perform time-series capture of brightfield, fluorescence, and phase contrast images at user-specified intervals. The temperature and $CO_2$ regulation chamber can hold a variety of vessels, including well plates, to create an ideal environment for specimens during prolonged time-lapse imaging.

Supports the installation of a stage-top compact incubator. Control temperature, $CO_2$ concentration, and humidity to perform extended imaging of live cells and cultured tissue.

Small gas tanks make it easy to perform time-lapse processes in places where there is no centralized piping or where the use of large tanks is difficult.
An automatic switching function allows worry-free imaging over a longer time.

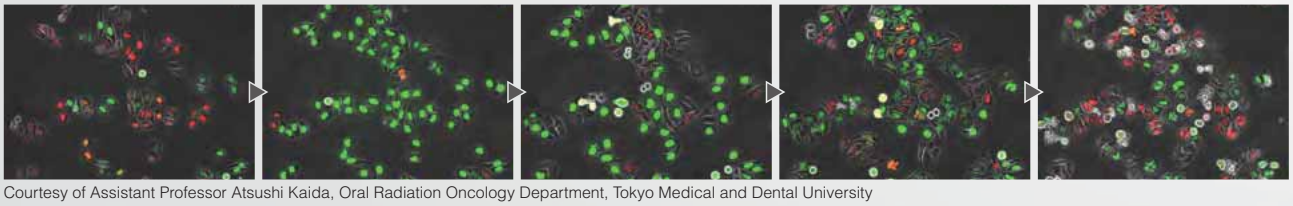
Use the touch panel to easily adjust temperature and $CO_2$ concentration.

## Time-series Brightness Measurement Function

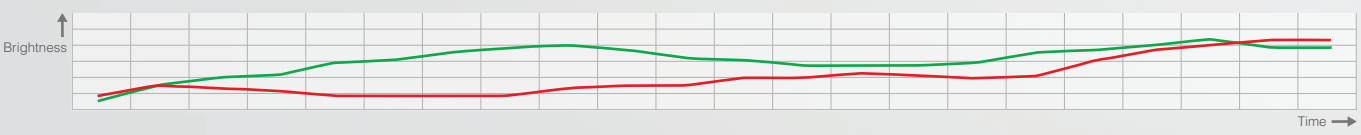
# Quantify Changes Over Time

This can provide time-series measurement of changes in RGB brightness in time-lapse images, allowing for quantitative evaluations along the time axis for experiments such as changes in gene expression. The high-intensity LED light source experiences little fluctuation in light intensity over time, enabling accurate quantitative measurement even during extended time-lapse processes.

FUCCI cell cycle checkpoints



Courtesy of Assistant Professor Atsushi Kaida, Oral Radiation Oncology Department, Tokyo Medical and Dental University

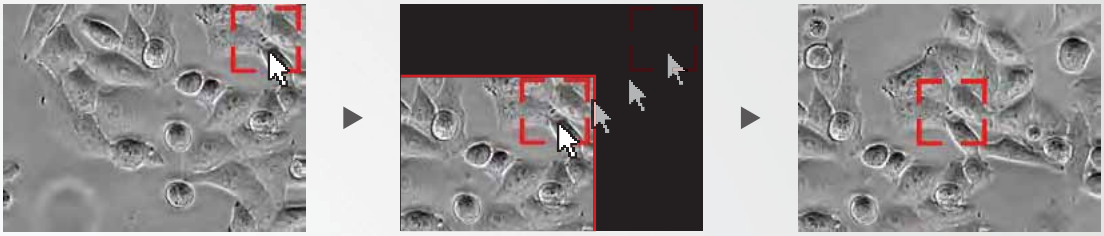


View time-lapse application videos ▶

# Position Adjustment During Time Lapse

### Adjust the field of view during time lapse capture

Adjust the capture position in the X, Y, and Z directions during time lapse in response to morphology changes and temperature drift. The function is performed using previously captured images, so sensitive samples are spared from additional light exposure.



The target is about to move out of the viewing area

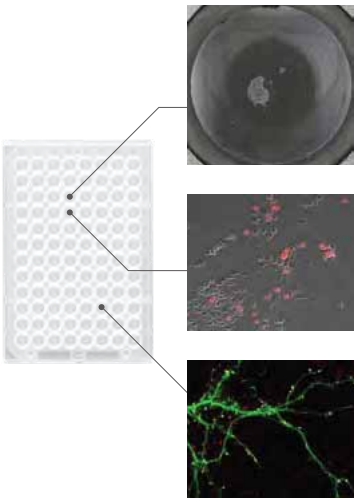
Readjust the X, Y, and Z capture position

Image capture resumes using the updated position

## BZ-H4XT Time-Lapse Module × BZ-H4XD Advanced Observation Module

### Coordinate-specific condition settings

Different capture conditions such as focal plane, exposure time, lens magnification, filters, and Z-stack width/step size can be set individually for each registered point. Multiple samples with different conditions can be imaged in the same time-lapse experiment for increased efficiency.



**For colony counting**

| | |
|---|---|
| Lens | Phase contrast 10× |
| Observation mode | Phase contrast image |
| Image stitching | 7×9 images |
| Z-stack | N/A |
| Exposure time | 1/70 s |

**For transfection efficiency**

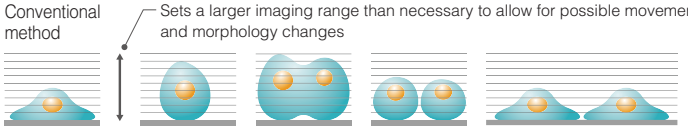
| | |
|---|---|
| Lens | Phase contrast 20× |
| Observation mode | Phase contrast + fluorescence overlay |
| Z-stack | 1.5 μ pitch, 8 images |
| Exposure time | Phase contrast 1/50 s, fluorescence 1/5 s |

**For cultured nerve cells**

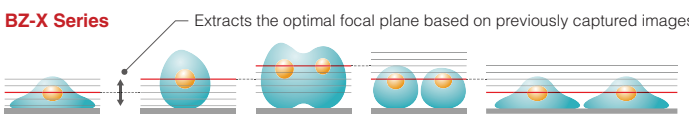
| | |
|---|---|
| Lens | Oil immersion 60× |
| Observation mode | Fluorescence 2CH overlay |
| Z-stack | 0.5 μ pitch, 10 images |
| Exposure time | CH1 1/6 s CH2 1/12 s |

### Focus tracking function

The optimal focal plane is automatically selected from Z-stack data. This plane is then set as the center of Z-stack for the next capture to ensure that the sample continues to be in focus. This decreases the number of images captured at each interval, which not only reduces capture time and file size, but also reduces the risk of photobleaching.




- Larger Z-stack means more images captured
- More exposure to excitation light increases risk of photobleaching




- Less images captured for more efficient review and analysis
- Minimizes sample's exposure to excitation light and reduces risk of photobleaching

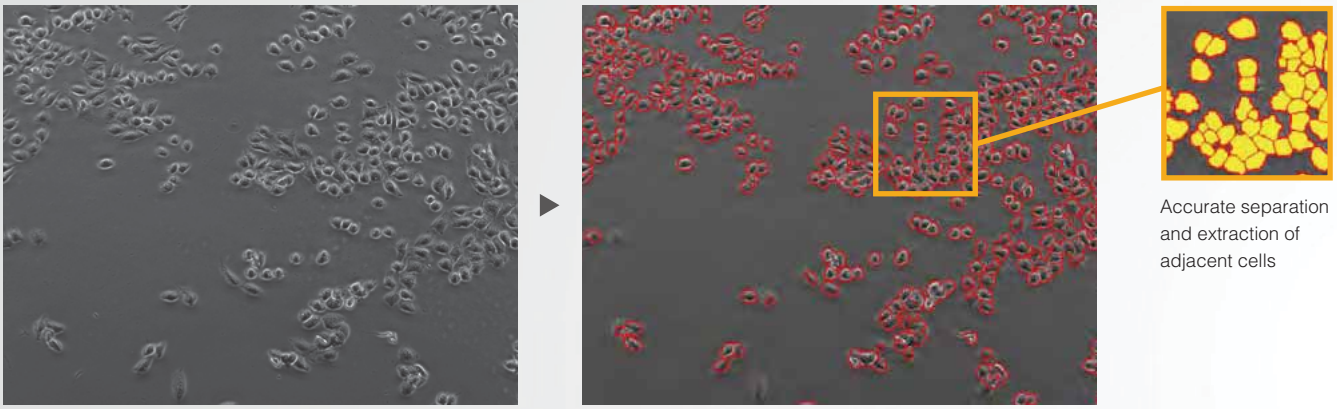
## Hybrid Cell Count

# High Accuracy Quantification Across Various Specimens

KEYENCE's original algorithm provides accurate quantification even for phase contrast images of cultured cells. The area of interest can be extracted and quantified quickly and accurately from phase contrast, brightfield, and fluorescence images. This easy-to-use software produces repeatable, user-independent results.

### Phase contrast

With conventional software, it is difficult to automatically count cell images with low contrast between the measurement area and the background. Hybrid Cell Count uses an original algorithm that enables the outlines of cells to be extracted accurately.

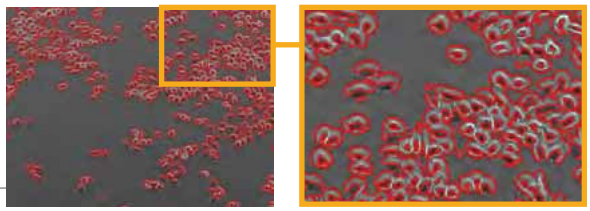


Accurate separation and extraction of adjacent cells

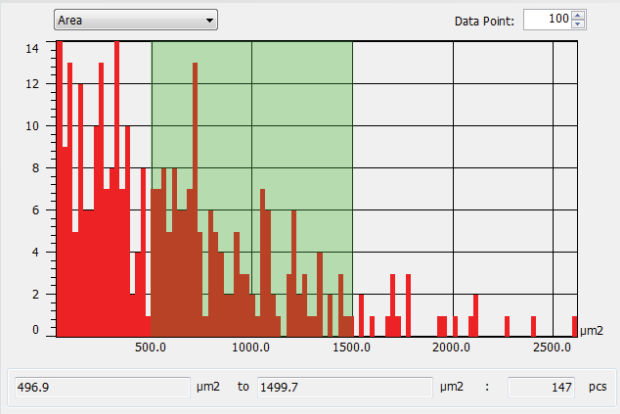
### Cell counting with conventional software

Uneven background brightness prevents cells from being extracted properly.

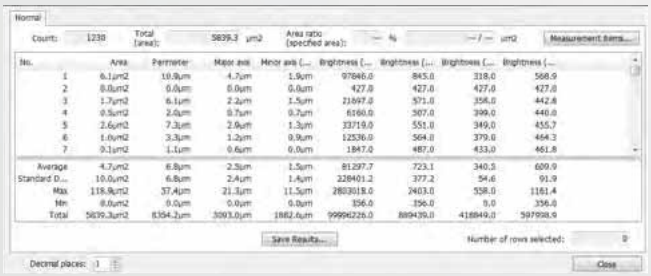
Low contrast makes it impossible to accurately differentiate and count the cells.



### Data output in spreadsheet format

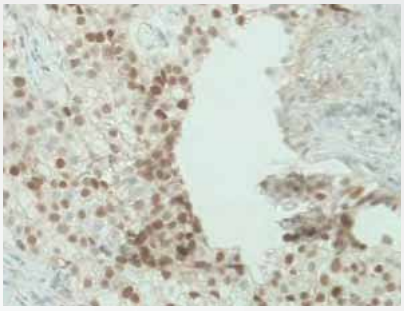



- Area
- Perimeter
- Major axis
- Minor axis
- Brightness (INT/MAX/MIN/AVE)
- RGB brightness (INT/MAX/MIN/AVE)
- Ferret diameter (X/Y)
- Count
- Area ratio, etc.



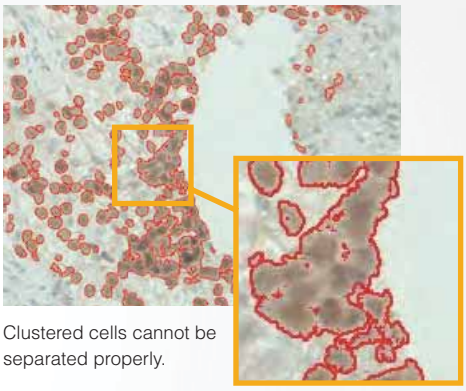
## Color extraction

Cells are extracted based upon hue differences and brightness information. Even clusters of cells can be separated and accurately quantified.



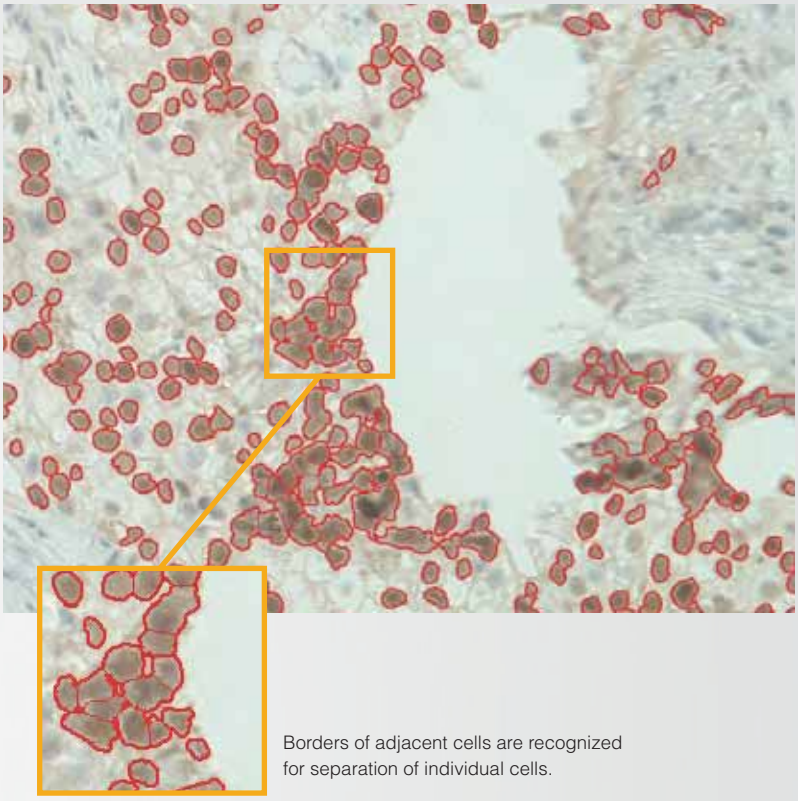
Courtesy of Koji Arihiro, M.D. Ph.D.,
Department of Anatomical Pathology, Hiroshima University Hospital

Conventional



Clustered cells cannot be separated properly.

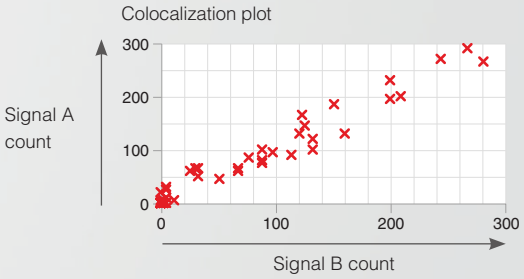
**BZ-X Series**

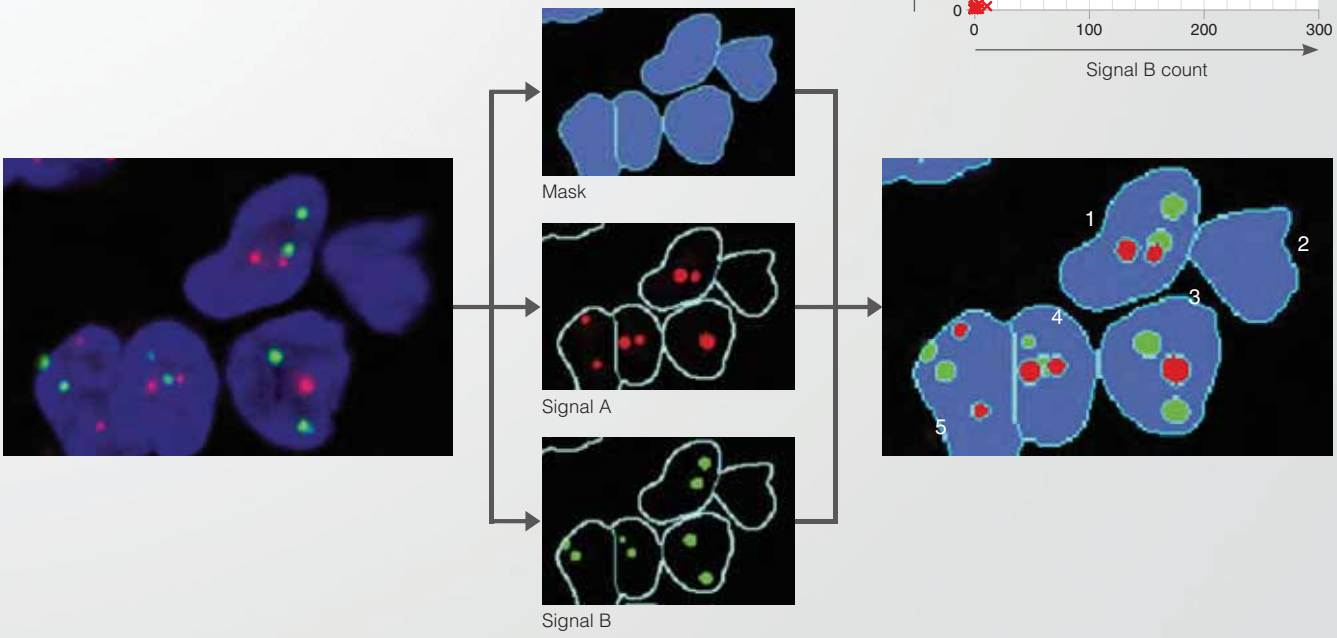


Borders of adjacent cells are recognized for separation of individual cells.

## Masking function

Users can specify a mask area from which to extract individual measurement areas. This allows for both individual measurement data and area ratios to be reported with ease. Up to two different extractions can be performed within the same mask area in order to quantify and compare multiple stains or conditions.



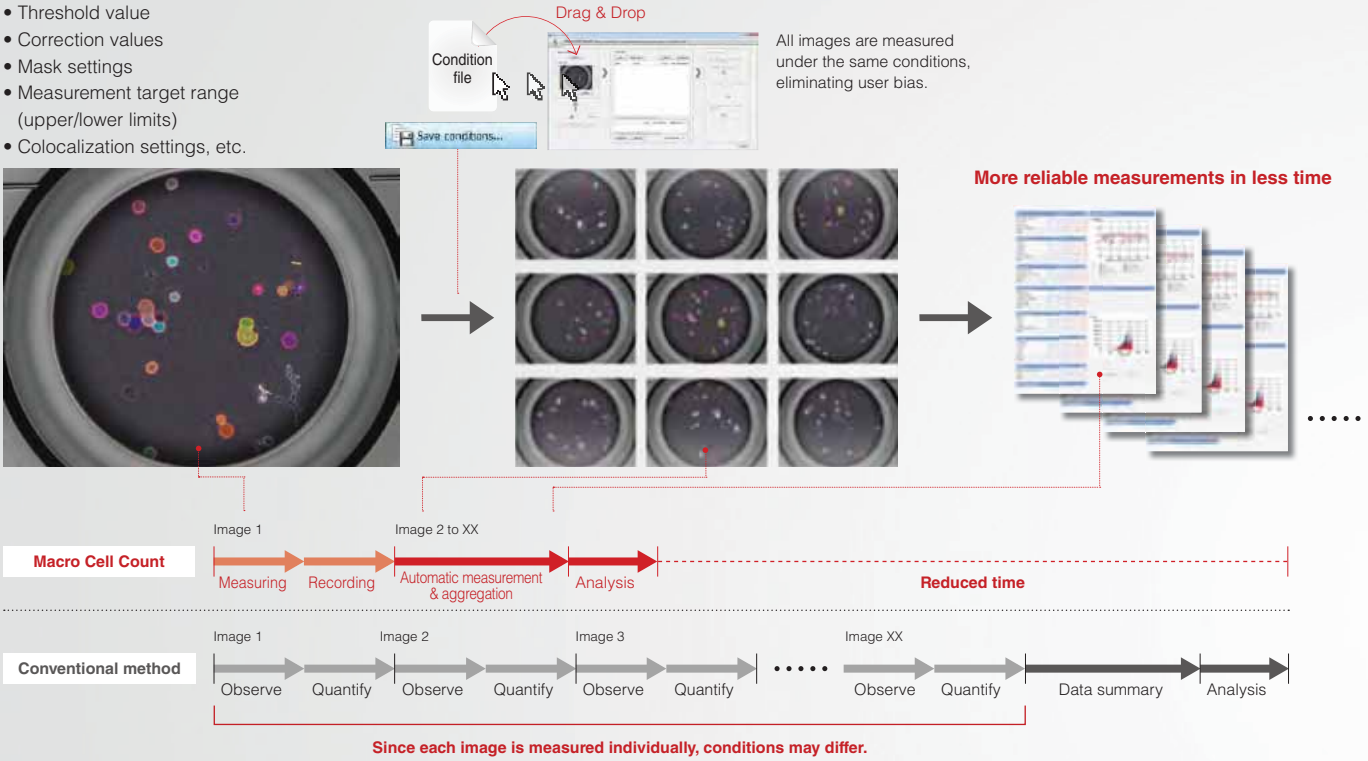
## Macro Cell Count

# Batch Processing for Repeatable Quantification

Once the appropriate measurement parameters are set for a single image, the same conditions can be applied to multiple images. This drastically reduces the amount of time needed for measurement, while improving data reliability by eliminating variations in measurement conditions.

Output conditions

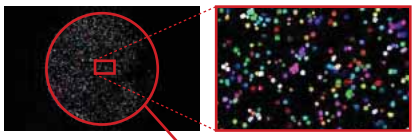
- Threshold value
- Correction values
- Mask settings
- Measurement target range (upper/lower limits)
- Colocalization settings, etc.



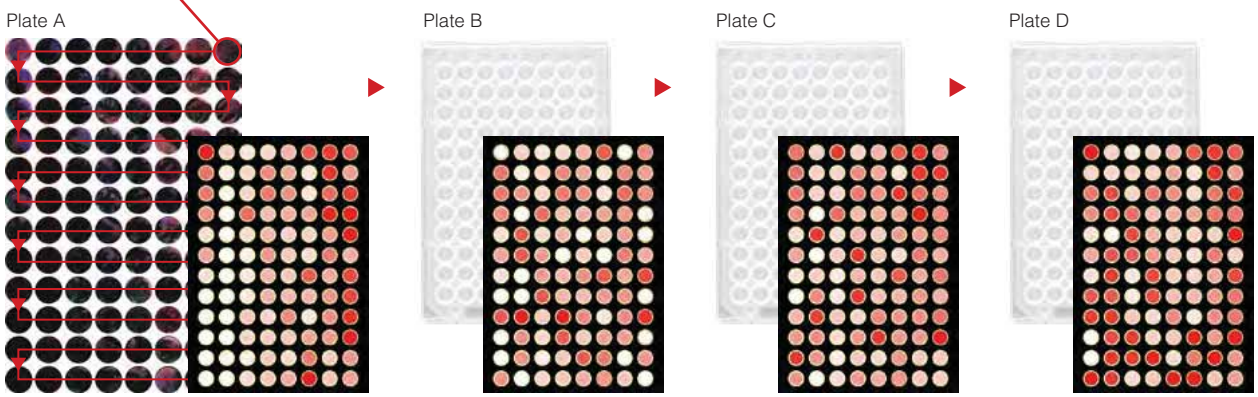

## Batch Analysis of Multiple Plates

BZ-H4C × BZ-H4XD × BZ-H4XI

# High-Content Screening of Multi-Well Plates

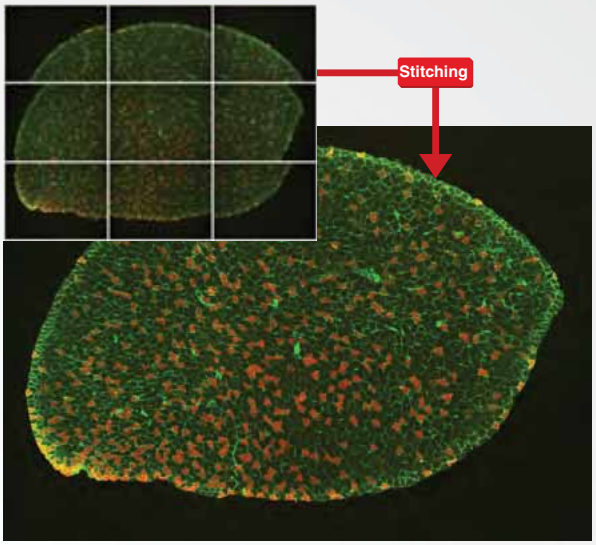


Automate batch processing of multiple well plates based upon specified measurement conditions.

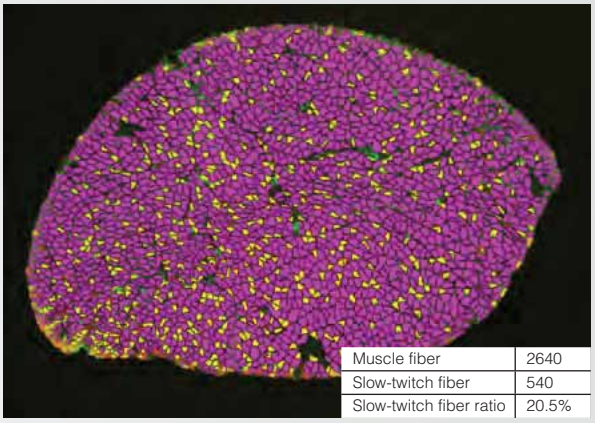


## Hybrid & Macro Cell Count Application Examples

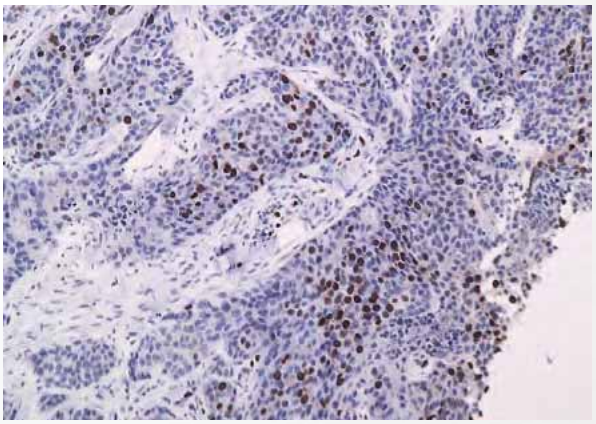
### Slow-twitch skeletal muscle fiber ratio

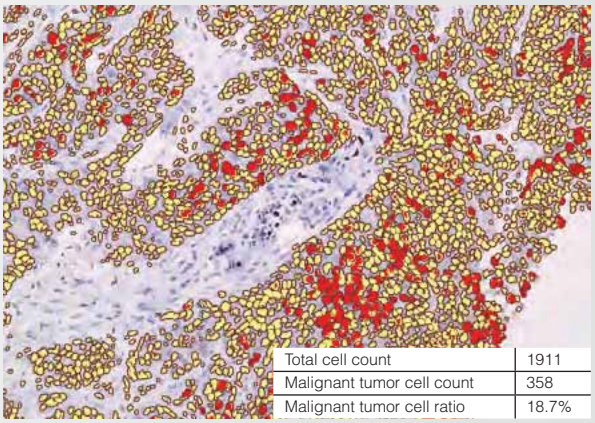



Courtesy of Lecturer Hideki Yamauchi, Division of Physical Fitness,
Department of Rehabilitation Medicine, Jikei University

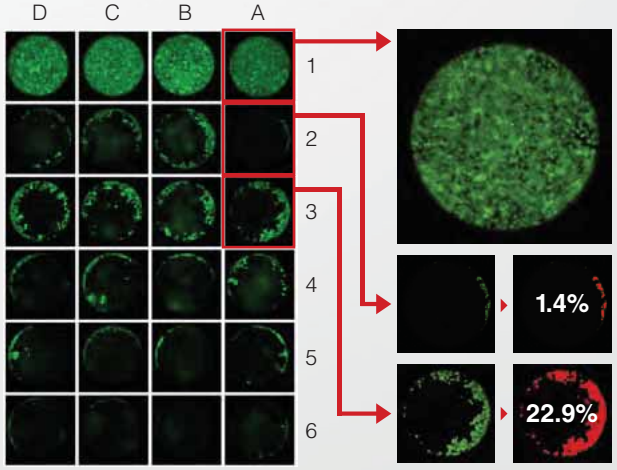


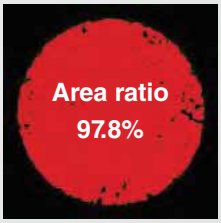

### Malignant tumor cell (MIB-1) count

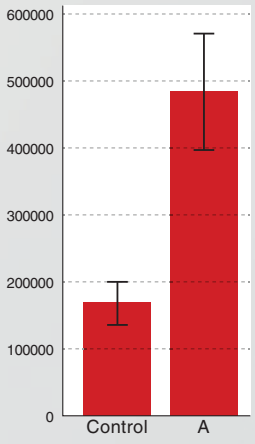





### Cell migration assays using multi-well plates (24 wells)



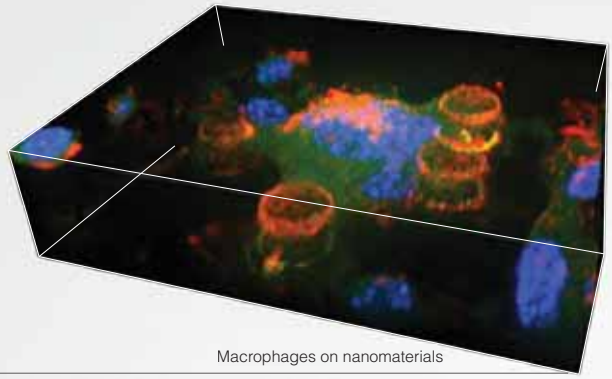



## 3D Analysis

# Accurate Analysis of 3D Localization

Transform Z-stacks into 3D renderings with a single click to accurately observe three-dimensional structures. Use new 3D measurement functions to quantify features such as shape and localization. Results can then be saved in image or video format for convenient viewing.

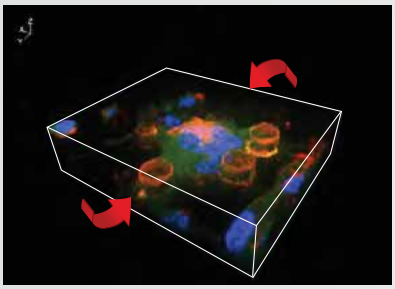


Macrophages on nanomaterials

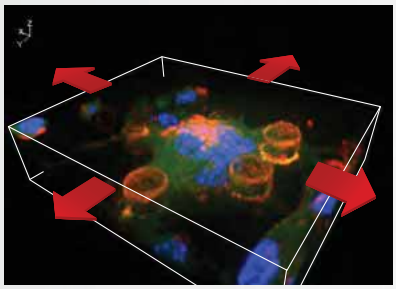
### 3D Display

#### Intuitive operation

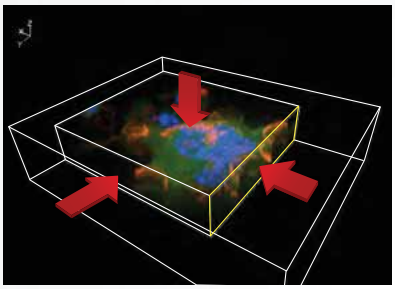
**Rotation**/ Click and drag to rotate



**Zoom**/ Use the mouse wheel to zoom in/out



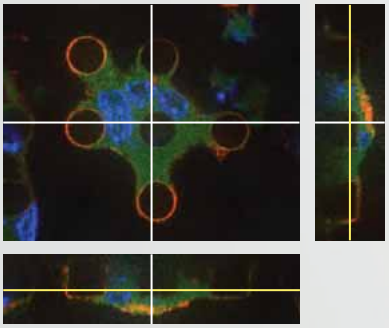
**Sectional view**/ Right-click to slice cross sections



#### Advanced 3D analysis

XY cross section

YZ cross section



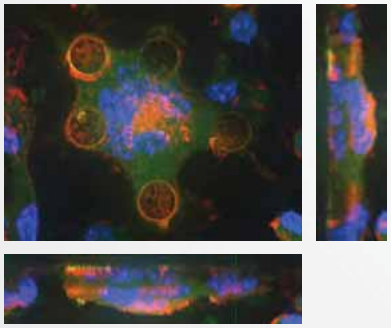
XZ cross section

**XYZ slicing**

An image can be sliced at any XYZ position to observe the cross-sectional view.

XY

YZ



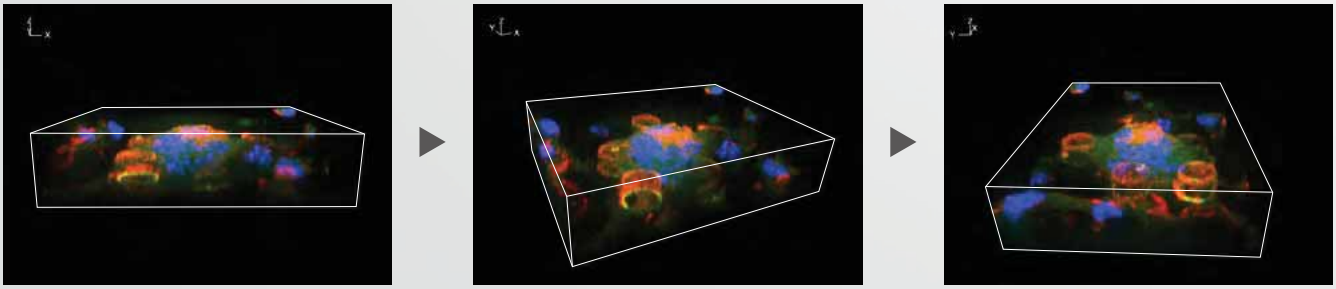
XZ

**Maximum projection**

Pixels with the maximum brightness in the Z-axis are combined to display an image with a large depth-of-field.

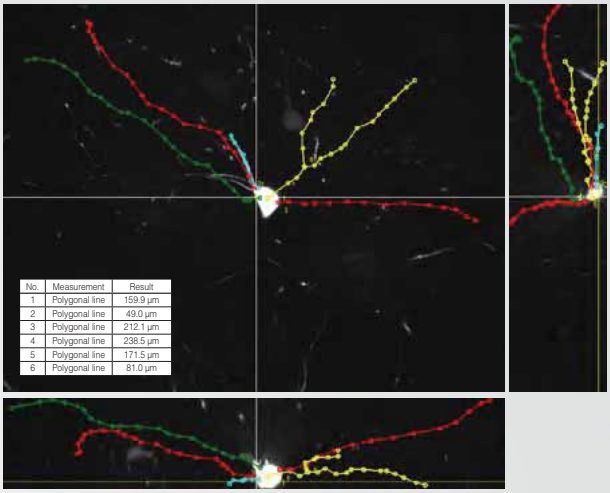
#### Video creation

3D images can be saved and played back as a video. Since videos are saved in a standard format, they can be viewed in any standard software and embedded within presentations and other documents.



## 3D Measurement

Click a measurement point on a cross section and scroll through the Z-stack images to accurately measure even complex 3D shapes, such as axons of neurons. The count function enables simple and convenient counting of 3D localization for FISH studies.



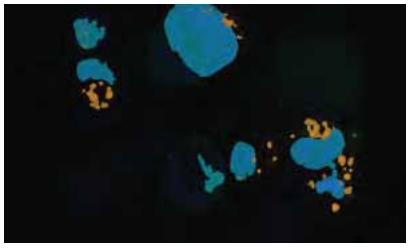

### Intuitive measurement menu


## 3D Cell Count

**BZ-H4R** × **BZ-H4C**

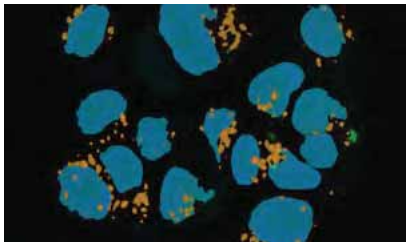
# One-Step Three-Dimensional Quantification

Z-Stack: Plane A

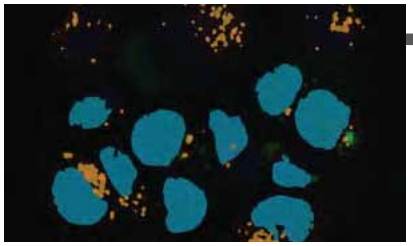


Instantly apply quantification conditions to an entire Z-stack. Quantify features such as volume, surface area, and intensity of extracted areas. Specified measurement conditions are applied to the Z-stack in real-time, allowing users to quickly view and optimize settings.

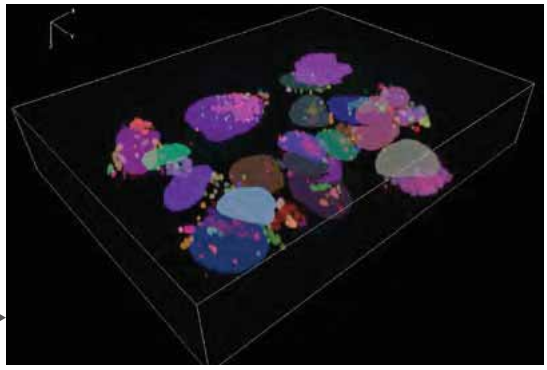
Z-Stack: Plane B

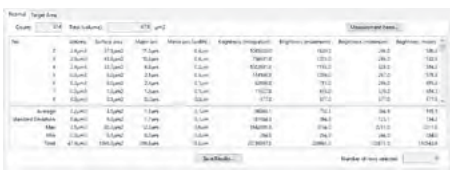


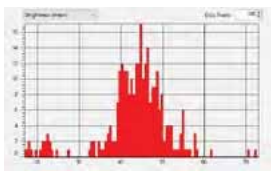
Z-Stack: Plane C



Measured areas that overlap on the Z axis are automatically integrated.





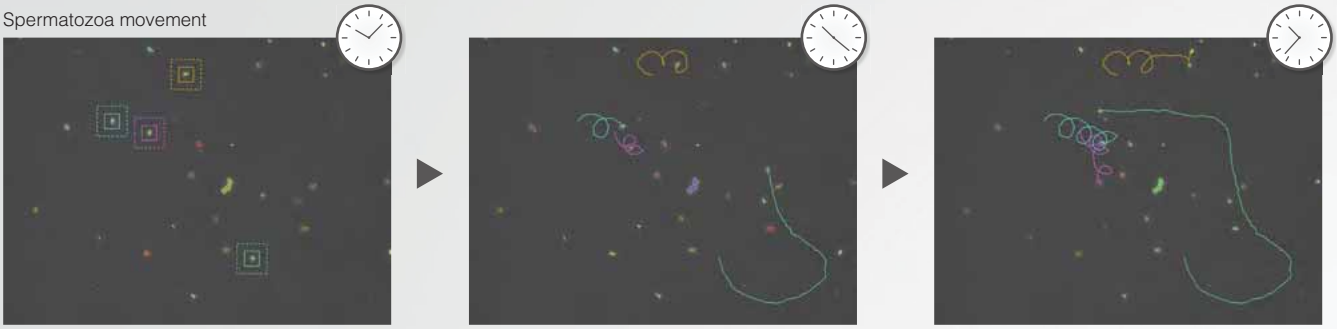


## Motion Analysis

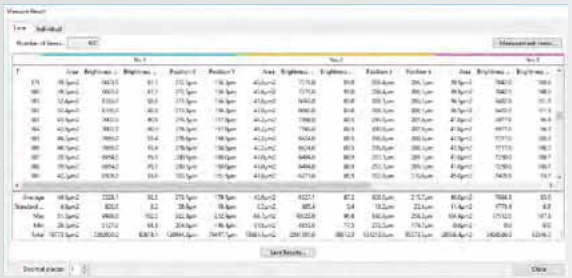
# Track Movement Over Time

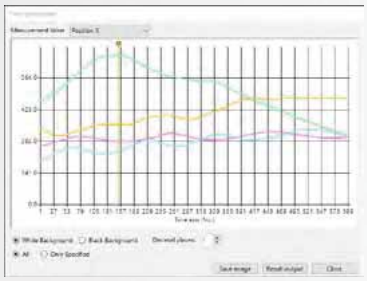
Select a target and track it using brightness, hue, and appearance information. Automatically record changes in coordinates to measure travel range, speed, and movement over time.

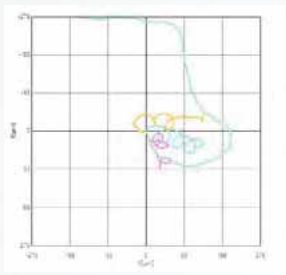
Spermatozoa movement



### Time-series data output







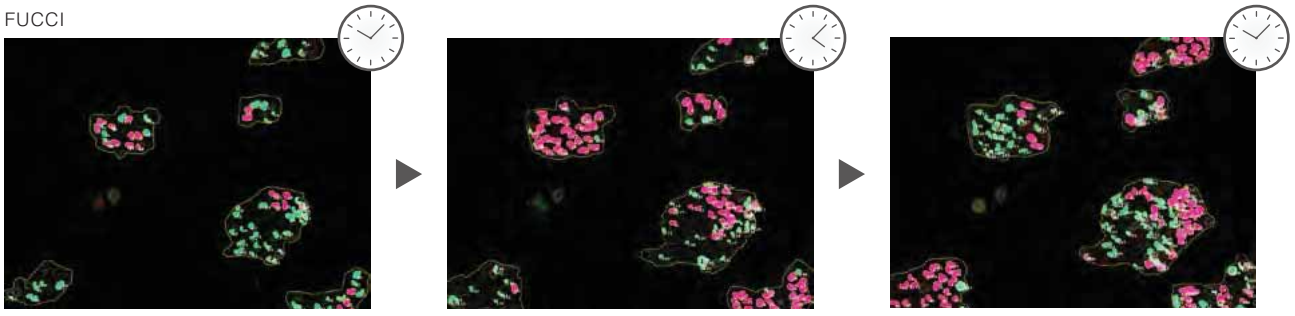
## Time-series Cell Count

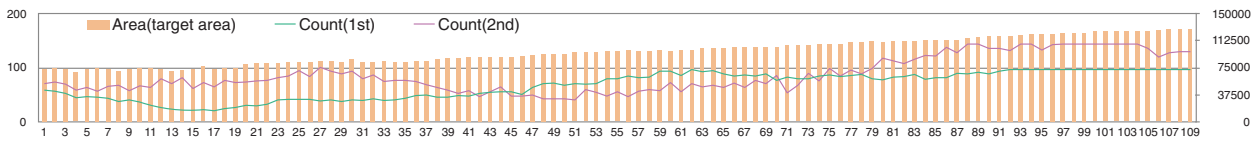
BZ-H4K × BZ-H4C

# Quantify Specimen Changes Over Time

Perform batch processing of high-precision quantification for video and time-lapse recordings. Quantify cell counts, surface areas, and signal intensities of extracted targets, and visualize results with time-series graphs. The data can then be exported for more in-depth analysis, such as correlating surface area expansion with changes in signal intensity.

FUCCI



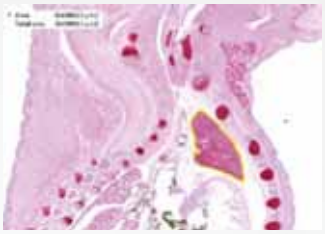


## Measurement

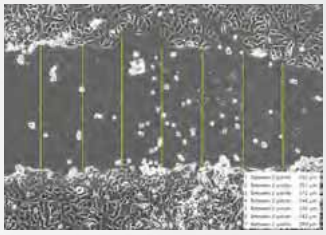
# Perform Point-and-Click 2D Measurements

A variety of 2D measurements can be made directly on the image simply by clicking the desired end points. This enables easy and accurate measurement, such as quantifying the axon length of neurons. RGB brightness values can also be quantified and visually displayed on a histogram.

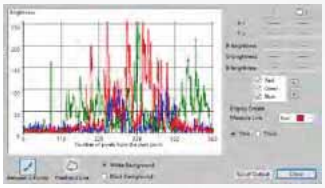
**Area**



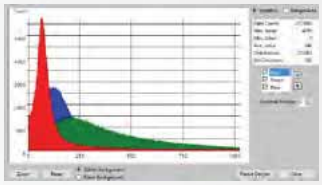
**Distance**



**Line profile**



**Histogram**

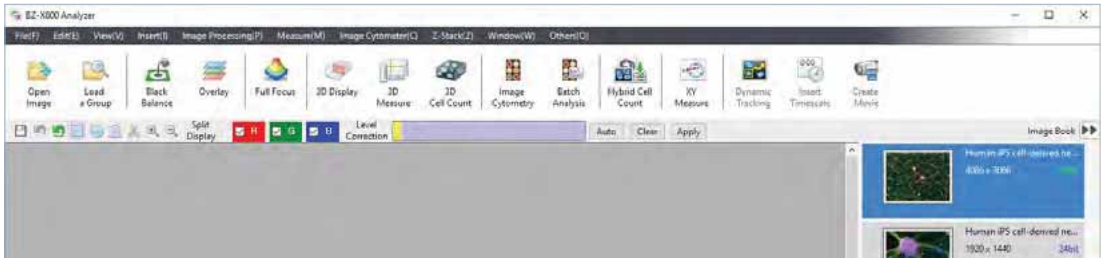


- 2 points
- Radius
- 2 centers
- Angle 1
- Angle 2
- Perpendicular line length
- Multi-point line length
- Free-form line length
- Circle area
- Free-form shape area
- Count
- Distance between parallel lines
- Polygon area

### BZ-H4A BZ-X800LE Analyzer

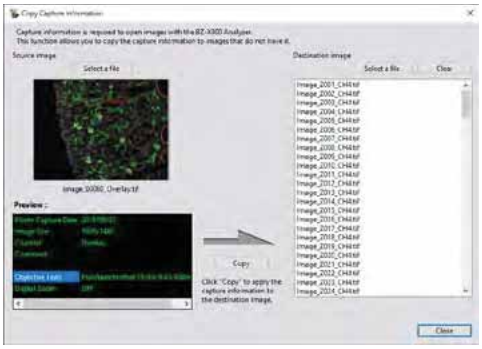
# Advanced Analysis Software

Perform analysis in the easy-to-use BZ-X800LE Analyzer. Capture conditions are stored in image metadata for automatic processing of Z-stacks, time-lapse, image stitching, and quantification.




# Analyze Data Captured with Previous Models

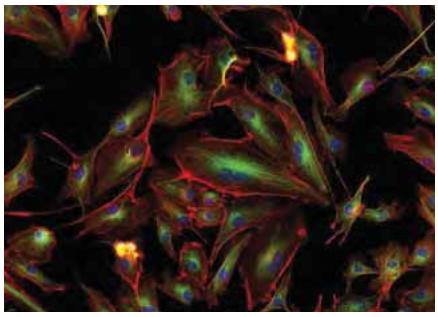
The “BZ-X800 Image Converter” analysis application is included as a standard feature. This allows data that has been captured with previous BZ Series systems to be converted to the latest format. Group settings data can also be converted, allowing the various functions of the BZ-X800LE analysis application to be used for advanced analysis.



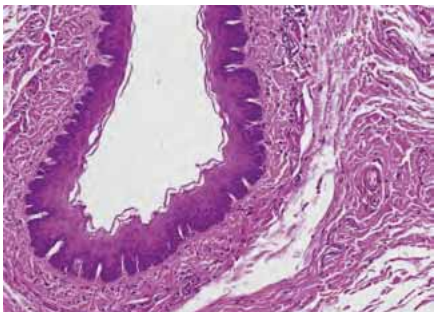
# Bright and Clear
# All-in-One Fluorescence Microscope Lenses


## Bright and clear with a wide wavelength

The wide wavelength range from ultraviolet to near-infrared yields a high transmission ratio to clearly observe both fluorescence and brightfield images.
Ideal for live cell imaging as bright fluorescence images can be obtained even with weak excitation light, minimizing damage to the cells.

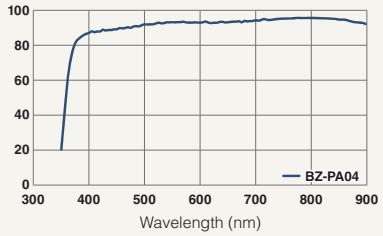


Skin cells inside the pulmonary artery of a cow



Esophagus

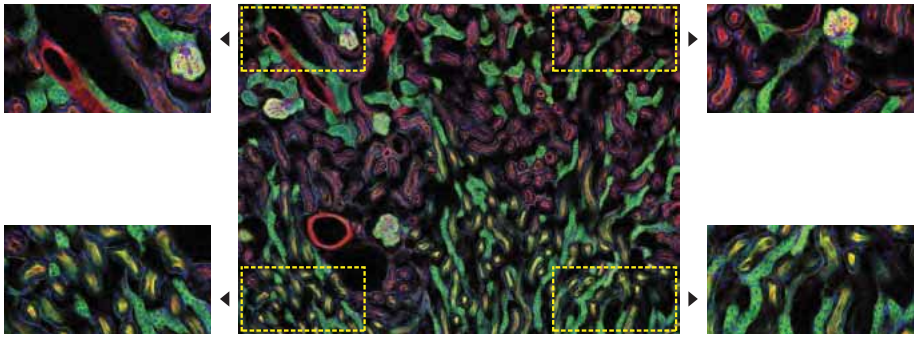
The wide wavelength range from ultraviolet to near-infrared yields a high transmission ratio.




With low phototoxicity due to minimal light diffusion and absorption by organic materials, the lenses have been greatly improved to handle the wavelength range of 650–900 nm, indispensable for deep observation and live-cell imaging.

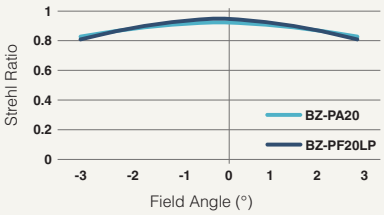
## High-grade optical design that minimizes distortion at the periphery of the field of view

Thoroughly corrects color and screen field curvature aberrations to respond to all capture conditions, from low magnification to high magnification, and from ultraviolet to near-infrared. Maintains high level of flatness extending to the periphery of the field of view. Can easily capture natural, vivid, multi-colored stitched images seamlessly.



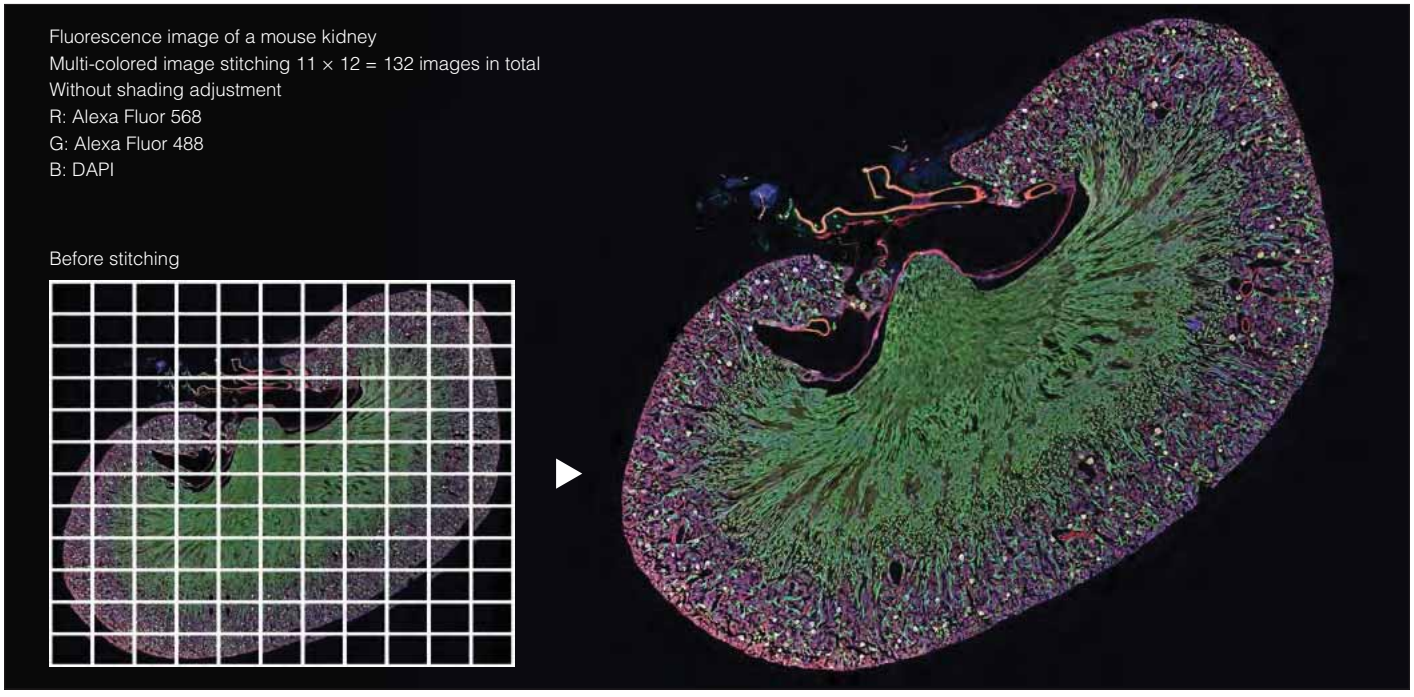
Mouse kidney

Achieves a high Strehl ratio from the center of the optical axis to the periphery

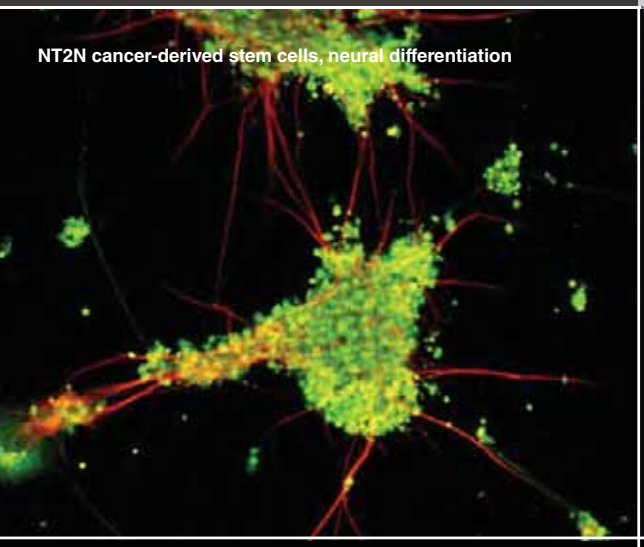



### What is the Strehl ratio?

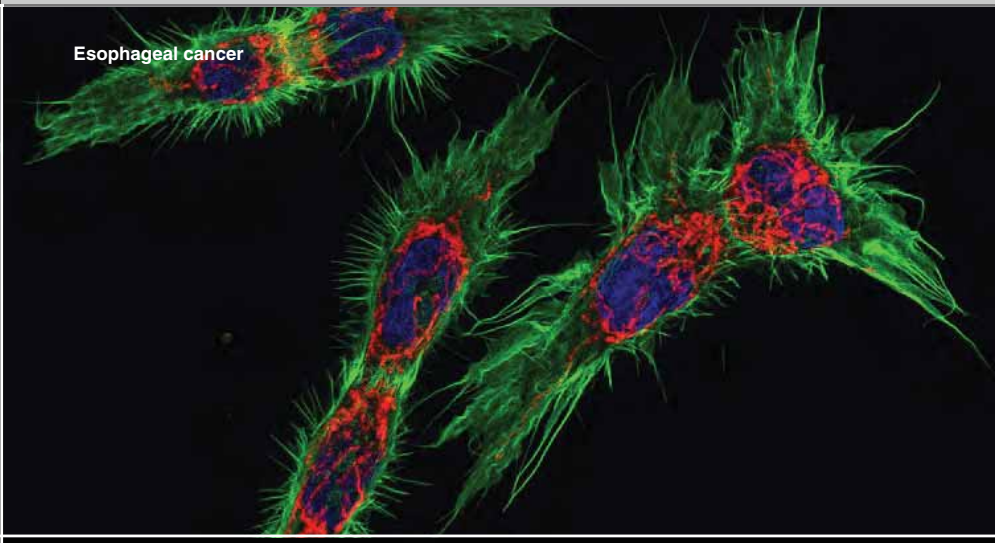
The Strehl ratio is the ratio of actual light intensity when compared to the maximum light intensity of the point source in an ideal optical system with absolutely no aberrations. It is generally preferable for objective lenses to have a ratio of 80% or higher.



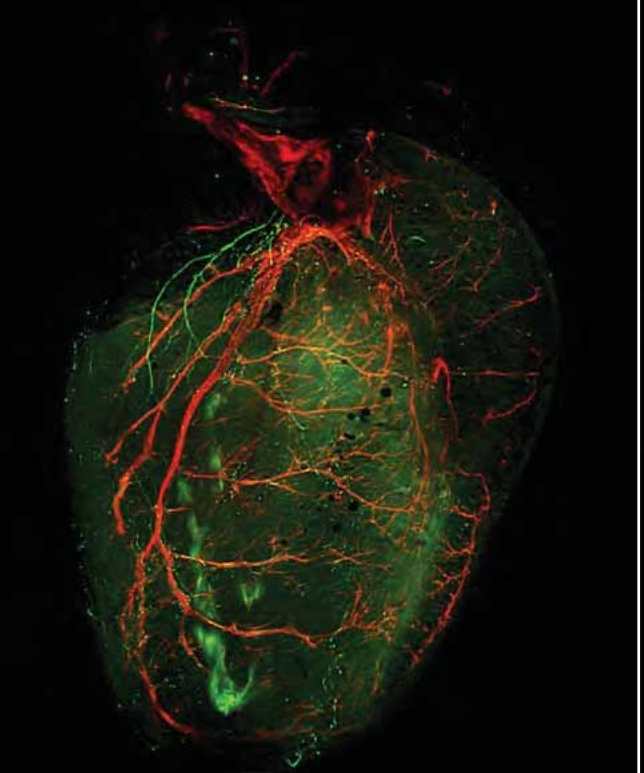
**NT2N cancer-derived stem cells, neural differentiation**



**Esophageal cancer**

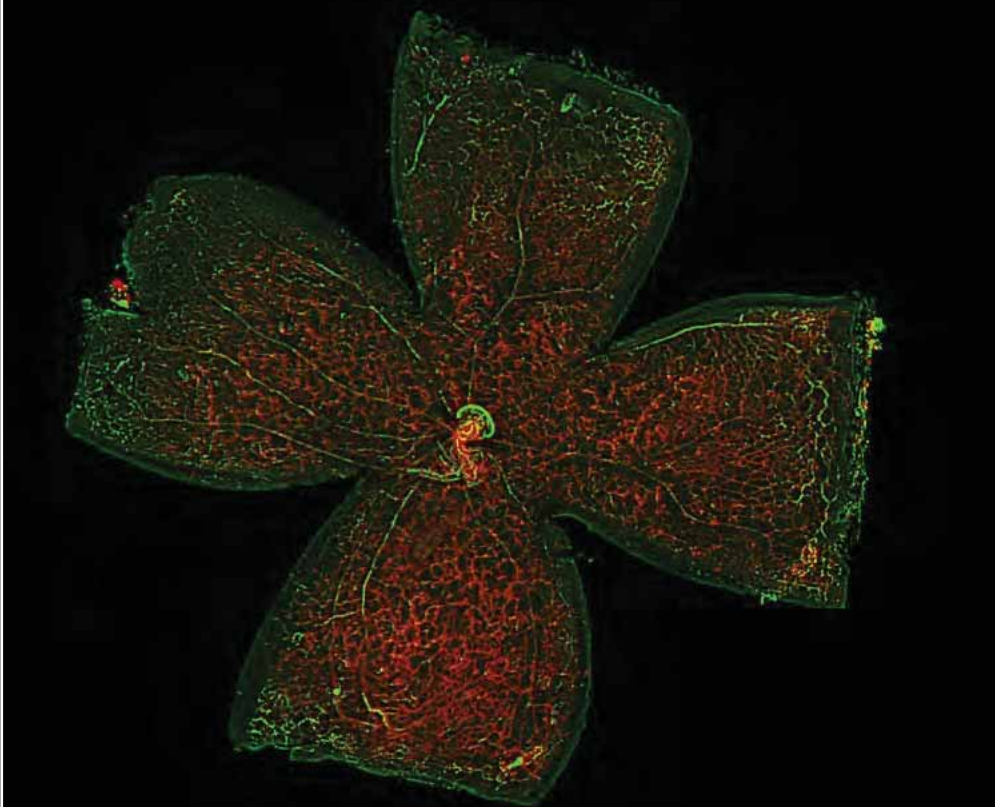


**Heart, sectioning image**



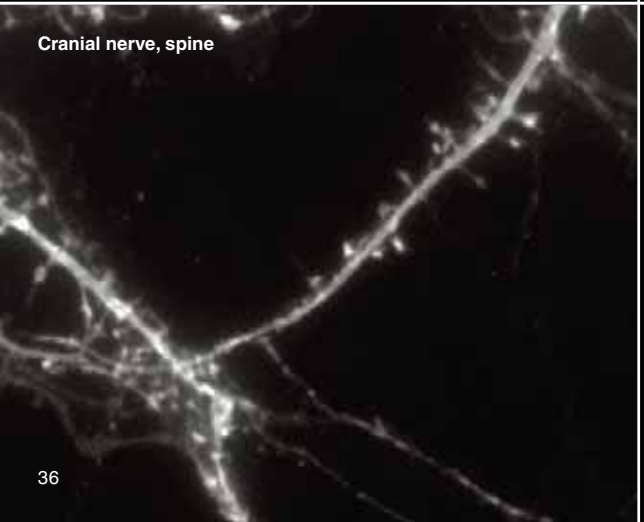
Courtesy of Dr. Koki Yokoyama, Department of Cardiovascular Medicine, Osaka University Hospital
Yokoyama et al. PLoS One. 2017 Jul 28;12(7):e0182072. doi: 10.1371/journal.pone.0182072. eCollection 2017.

**Mouse retina flat mount, angiogenesis**

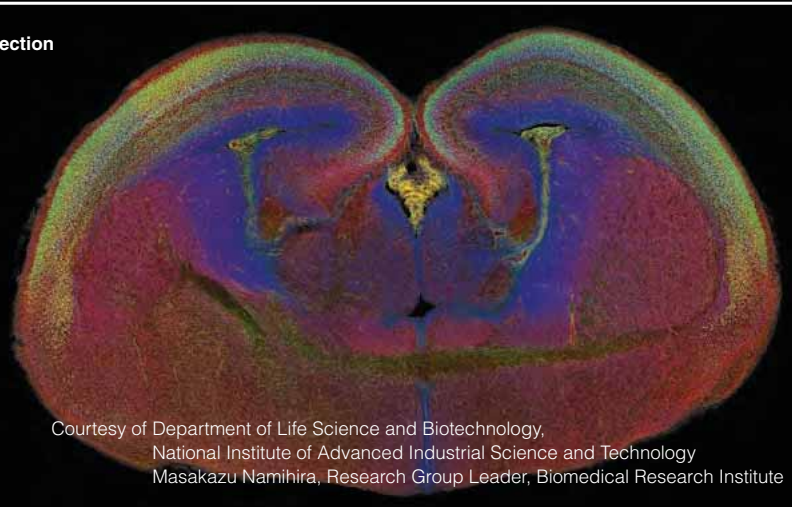


Courtesy of Professor Shigeki Higashiyama, Department of Biochemistry and Molecular Genetics, Ehime University Graduate School of Medicine

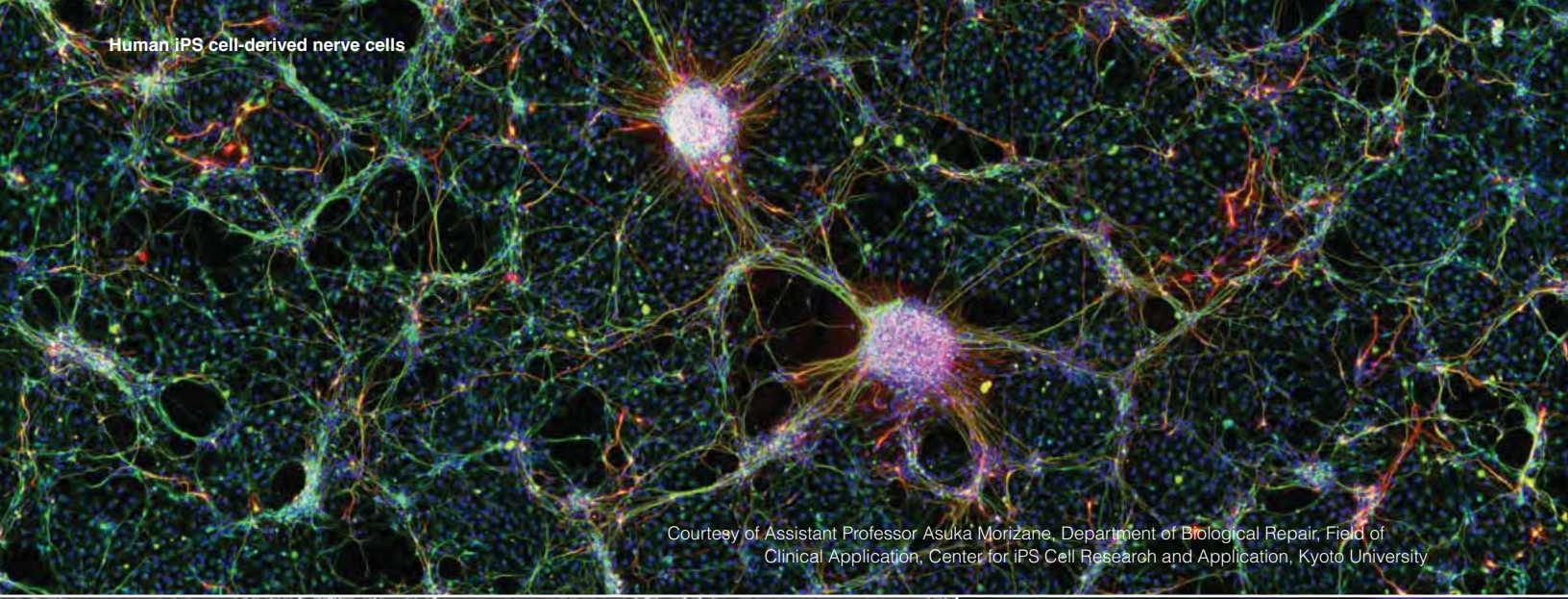
**Cranial nerve, spine**



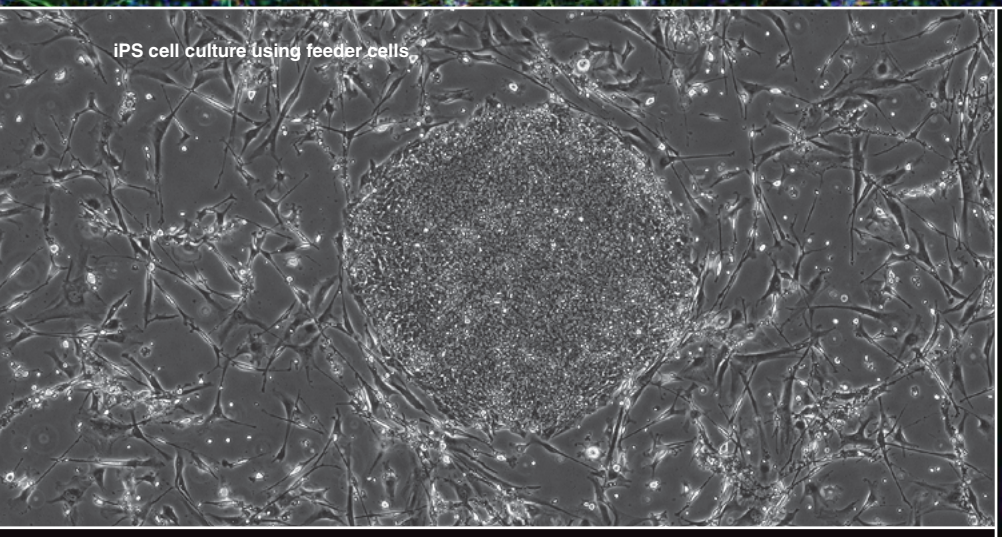
**Brain section**

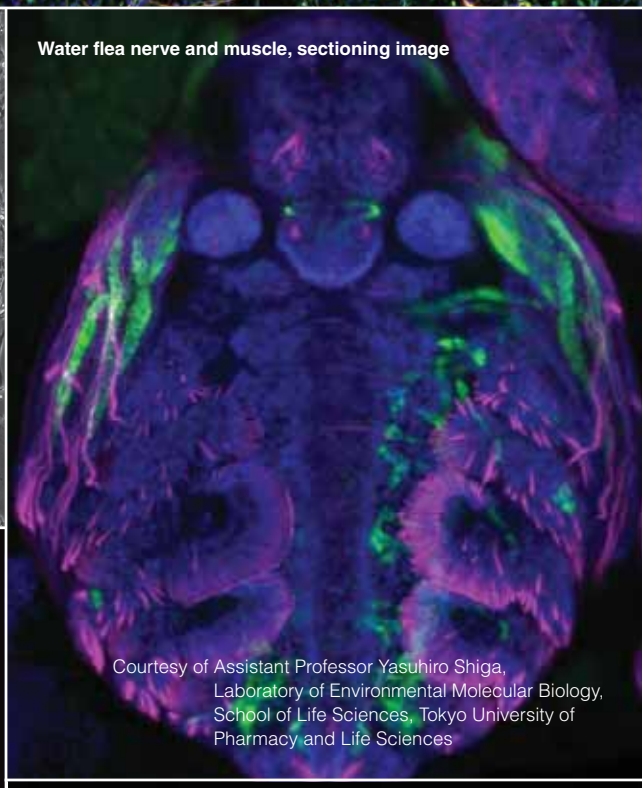


Courtesy of Department of Life Science and Biotechnology, National Institute of Advanced Industrial Science and Technology
Masakazu Namihira, Research Group Leader, Biomedical Research Institute

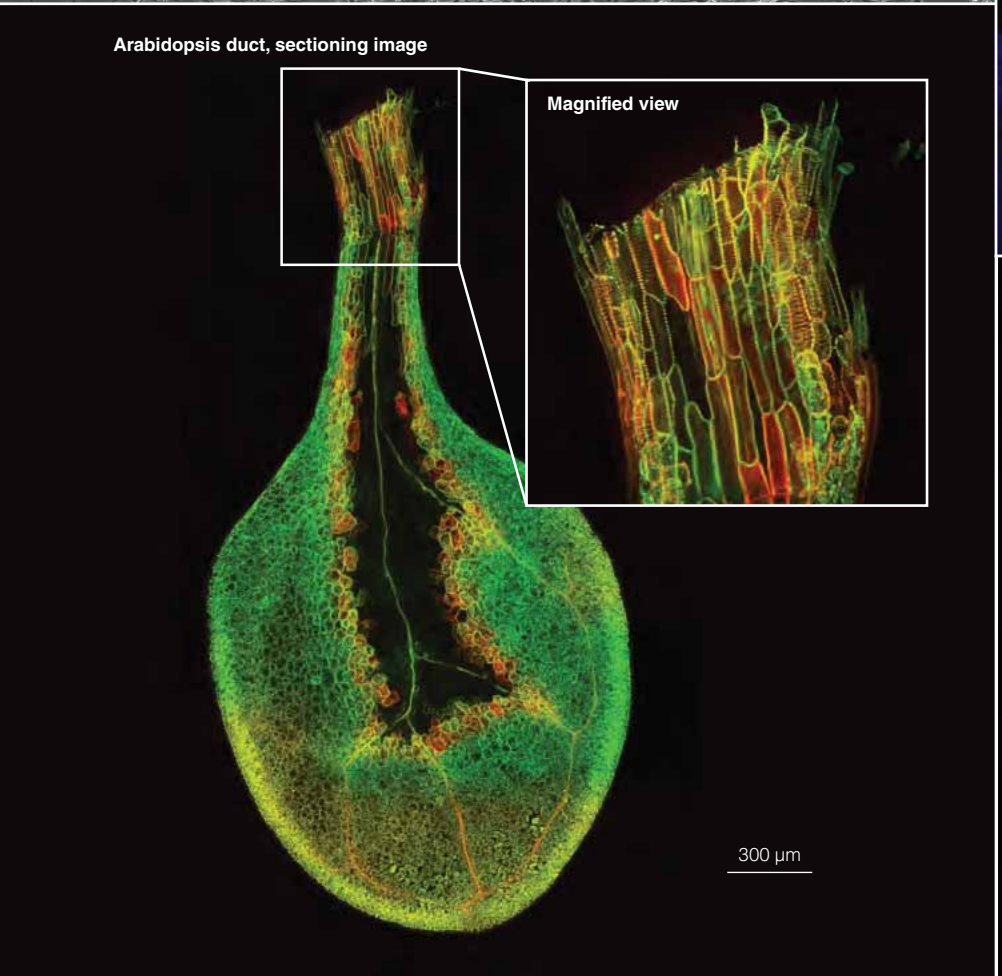



Courtesy of Assistant Professor Asuka Morizane, Department of Biological Repair, Field of Clinical Application, Center for iPS Cell Research and Application, Kyoto University



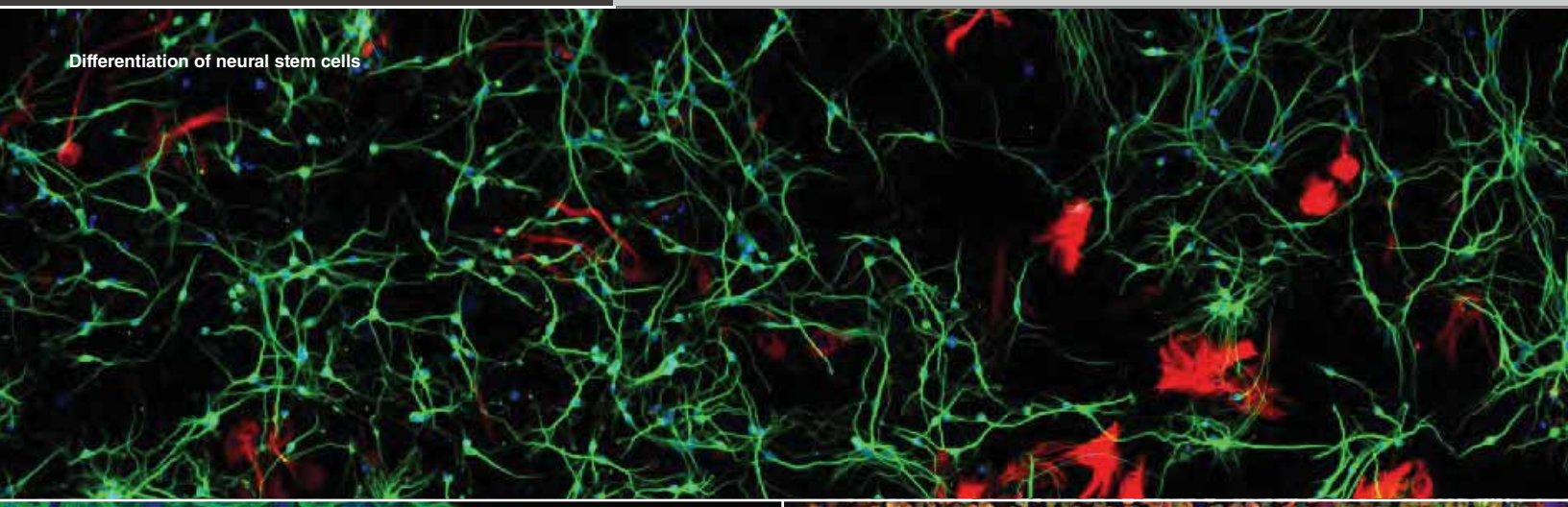




Courtesy of Assistant Professor Yasuhiro Shiga, Laboratory of Environmental Molecular Biology, School of Life Sciences, Tokyo University of Pharmacy and Life Sciences

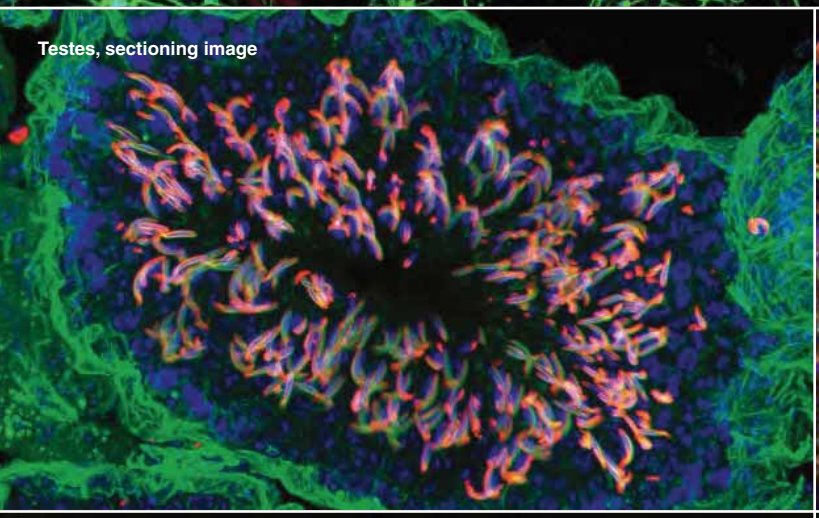




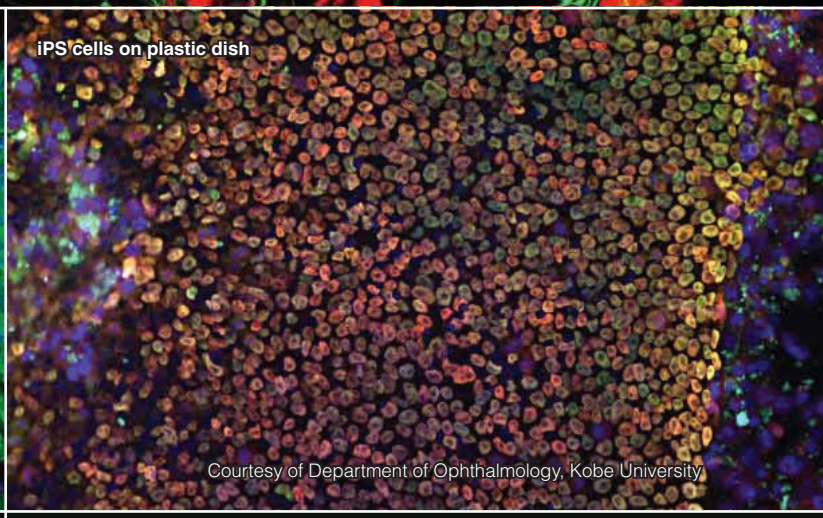
Courtesy of Lecturer Shingo Nakamura, Division of Biomedical Engineering, National Defense Medical College



Differentiation of neural stem cells

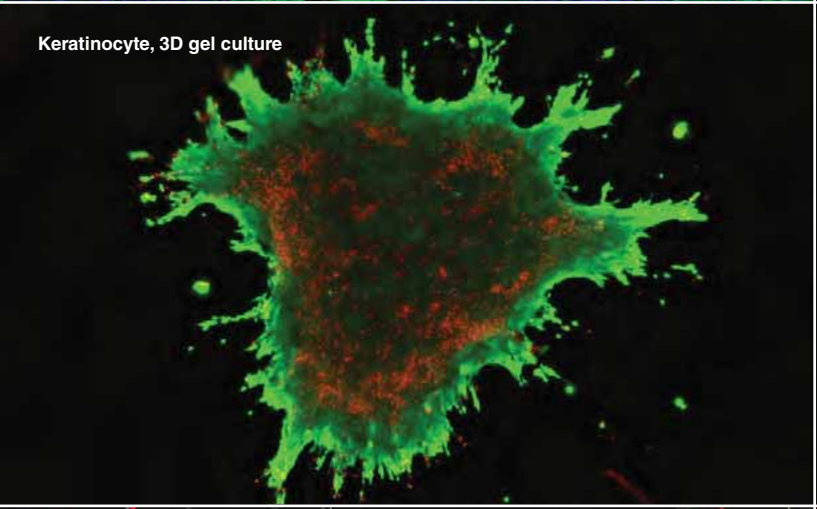


Testes, sectioning image



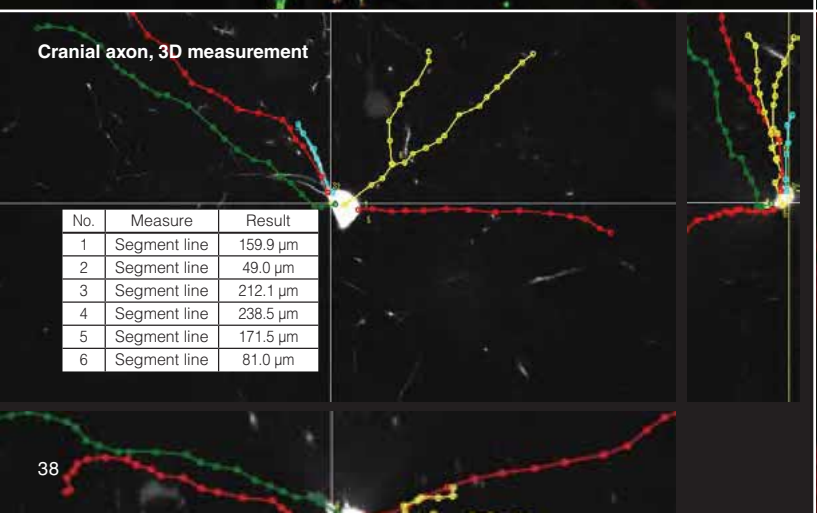
iPS cells on plastic dish

Courtesy of Department of Ophthalmology, Kobe University



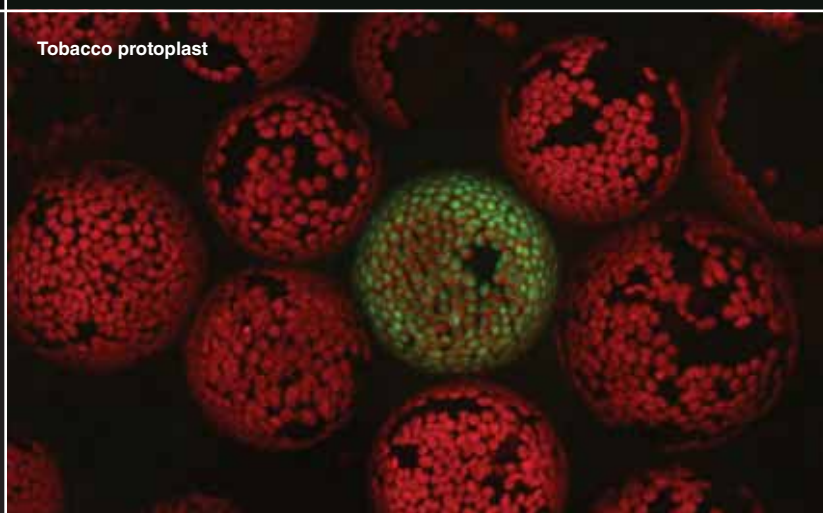
Keratinocyte, 3D gel culture

Drosophila brain, sectioning image

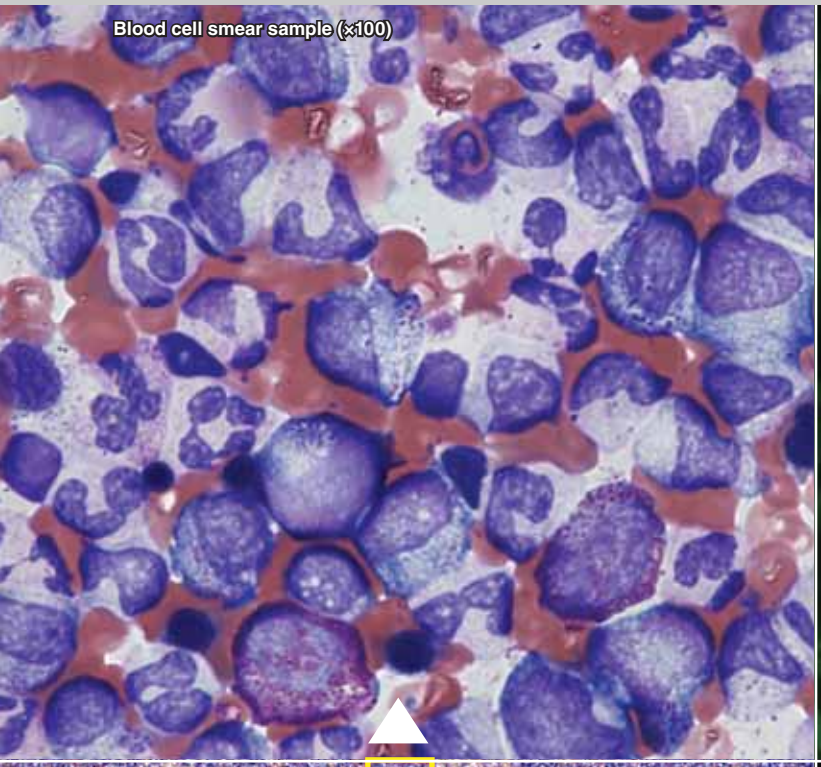


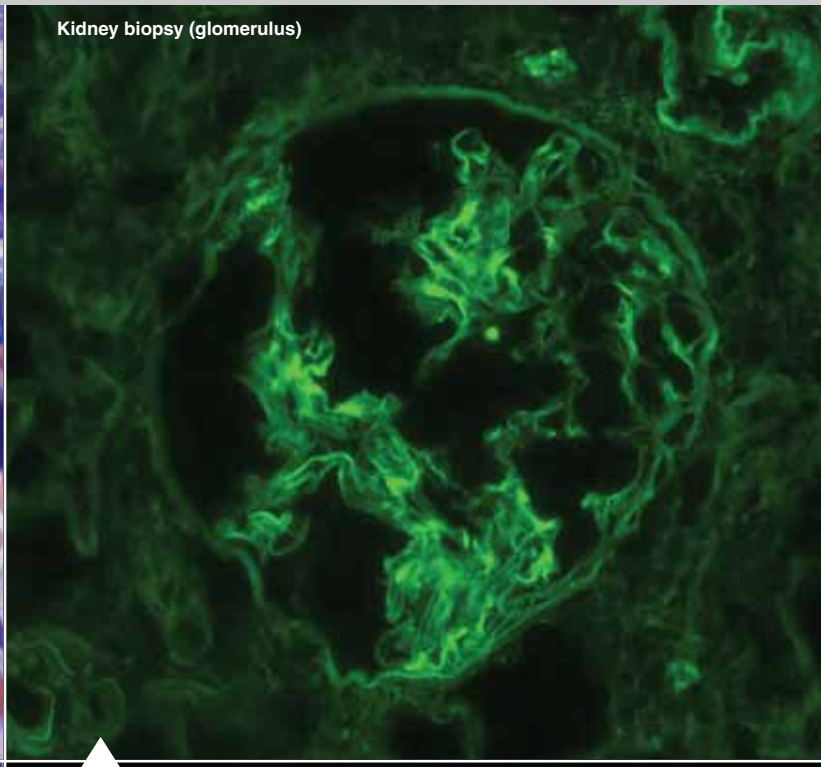
Cranial axon, 3D measurement

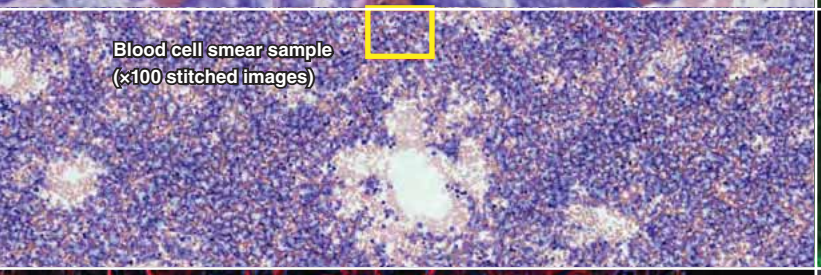
| No. | Measure | Result |
|---|---|---|
| 1 | Segment line | 159.9 µm |
| 2 | Segment line | 49.0 µm |
| 3 | Segment line | 212.1 µm |
| 4 | Segment line | 238.5 µm |
| 5 | Segment line | 171.5 µm |
| 6 | Segment line | 81.0 µm |

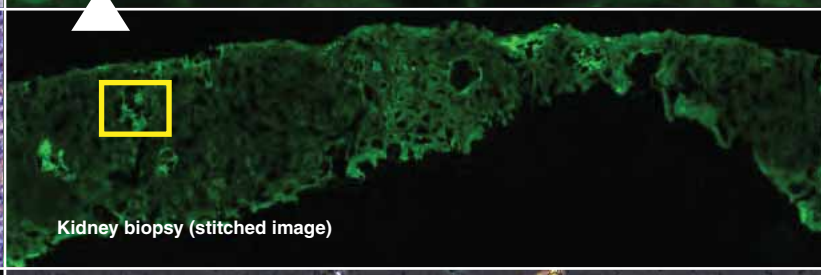


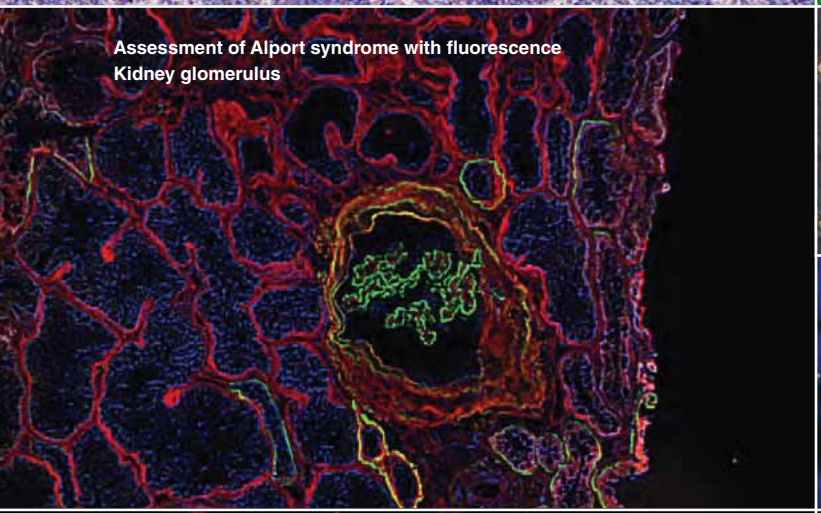
Tobacco protoplast

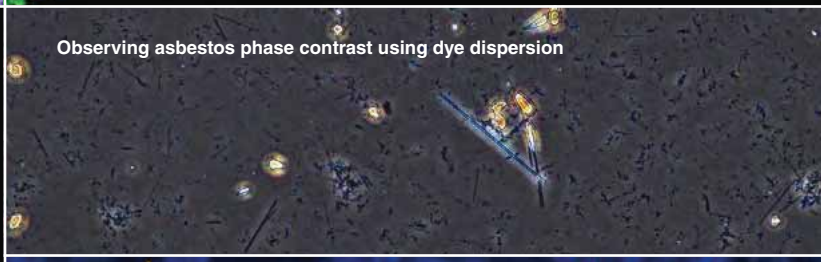

Blood cell smear sample (×100)

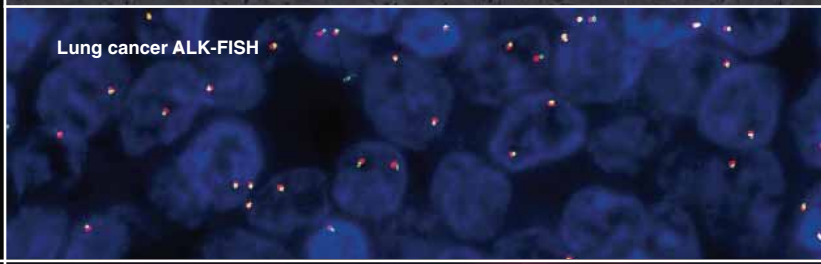

Kidney biopsy (glomerulus)

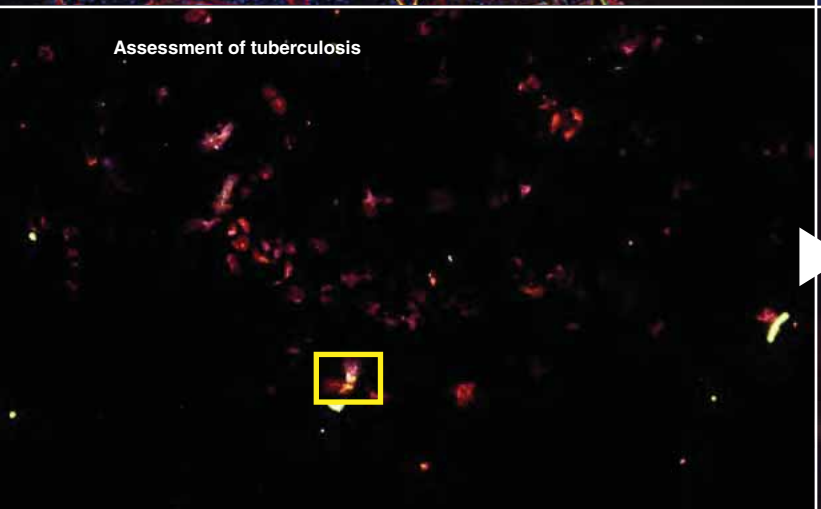

Blood cell smear sample
(×100 stitched images)


Kidney biopsy (stitched image)


Assessment of Alport syndrome with fluorescence
Kidney glomerulus

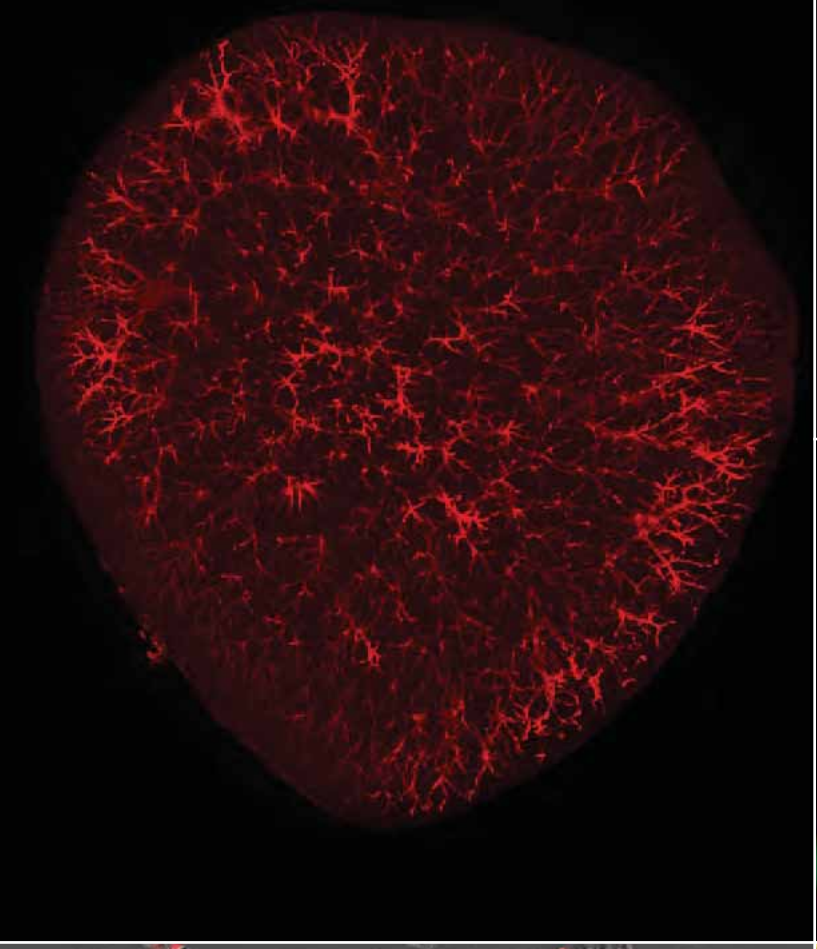

Observing asbestos phase contrast using dye dispersion


Lung cancer ALK-FISH


Assessment of tuberculosis

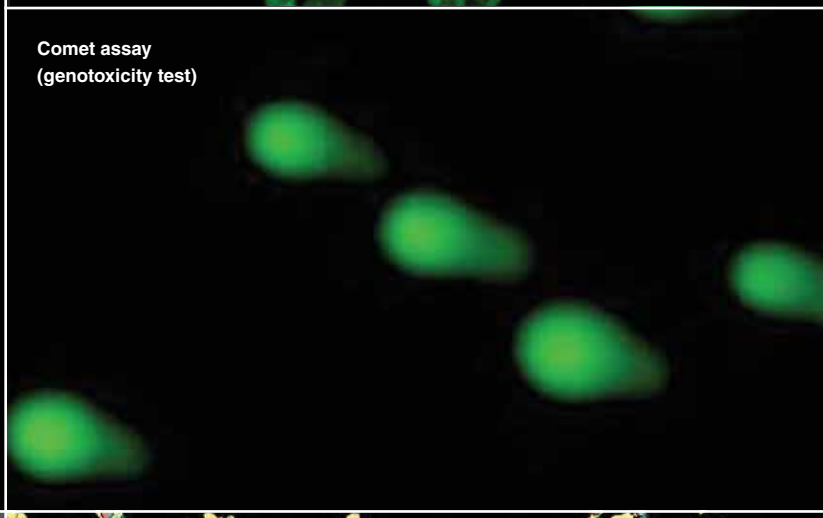

Acid-fast bacteria

Cleared kidney tissue, whole mount

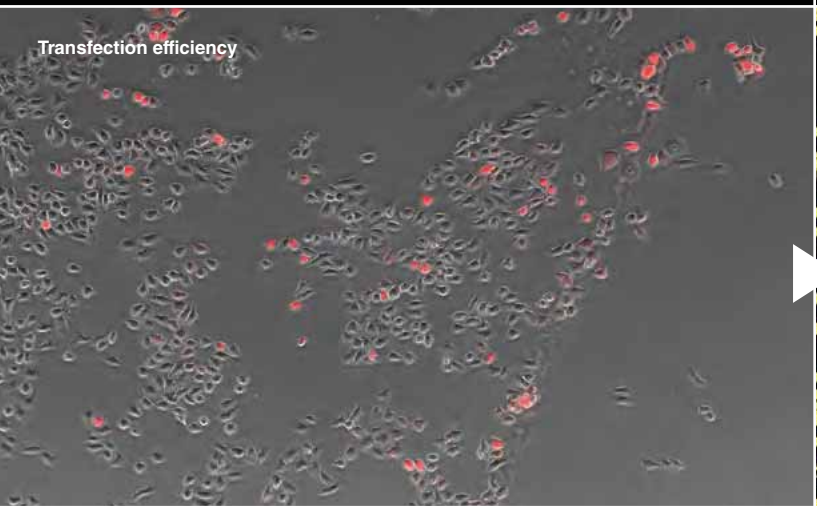


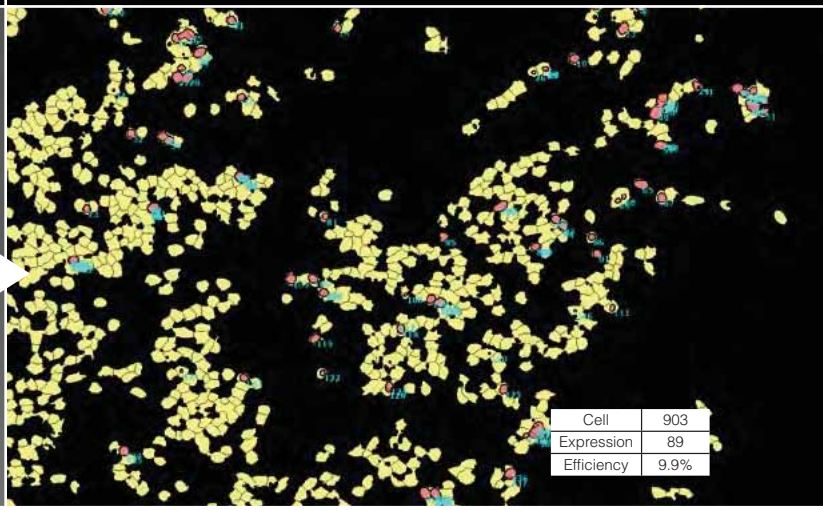
3D nephroid structure derived from tissue stem cells
(renal toxicity test)

Comet assay
(genotoxicity test)

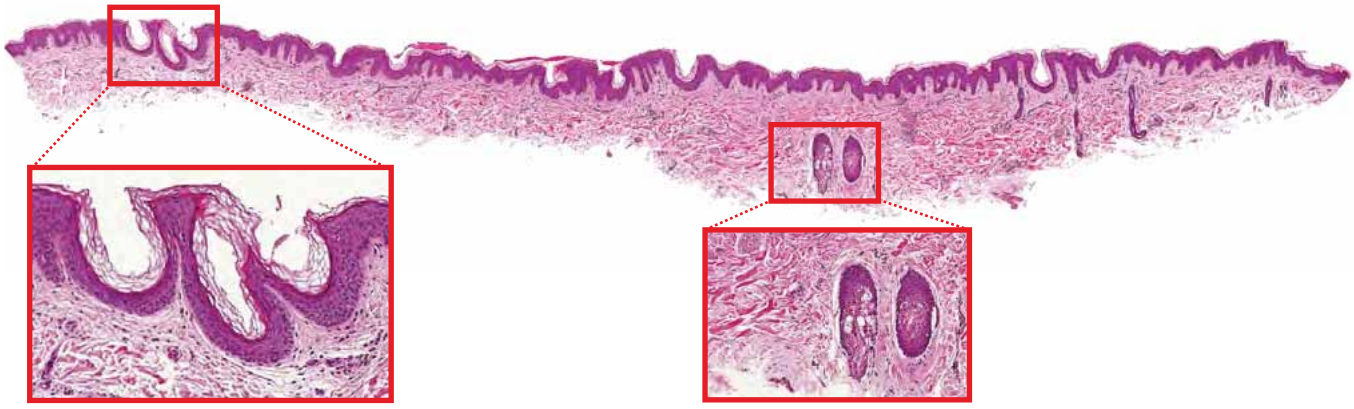


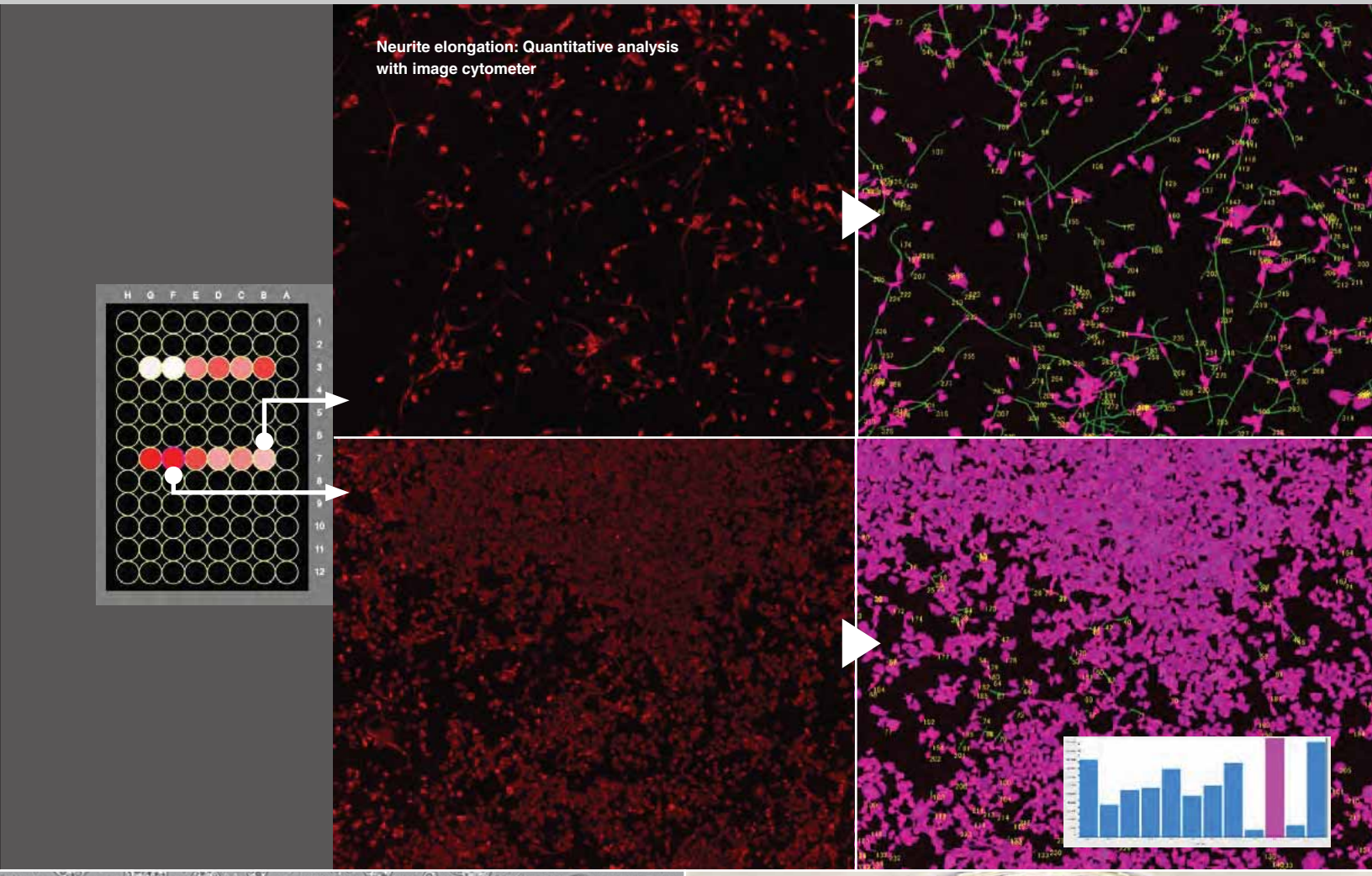
Transfection efficiency

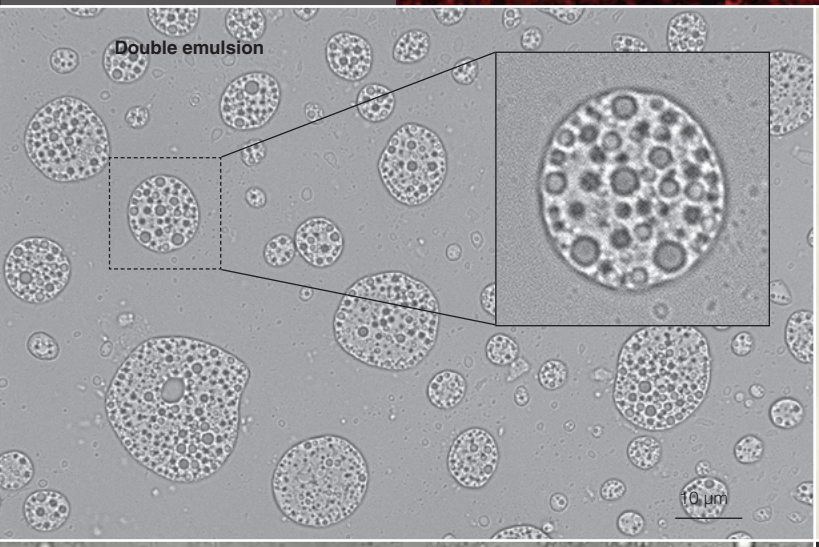




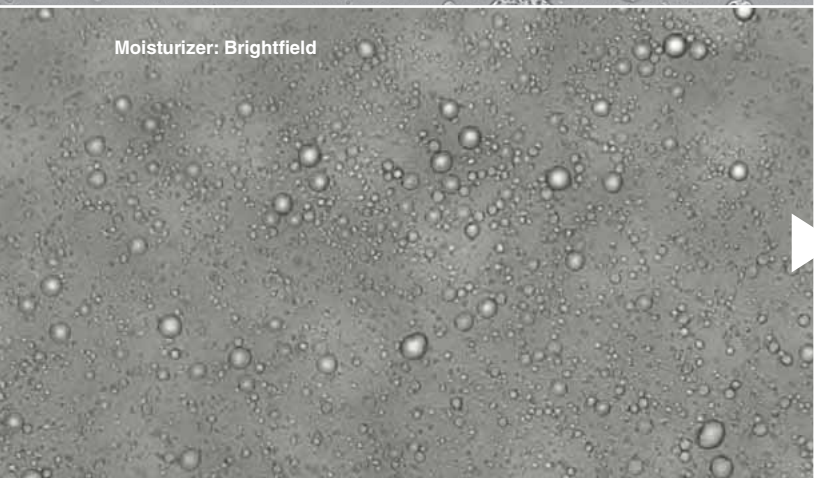

UV-damaged parts of the epidermis

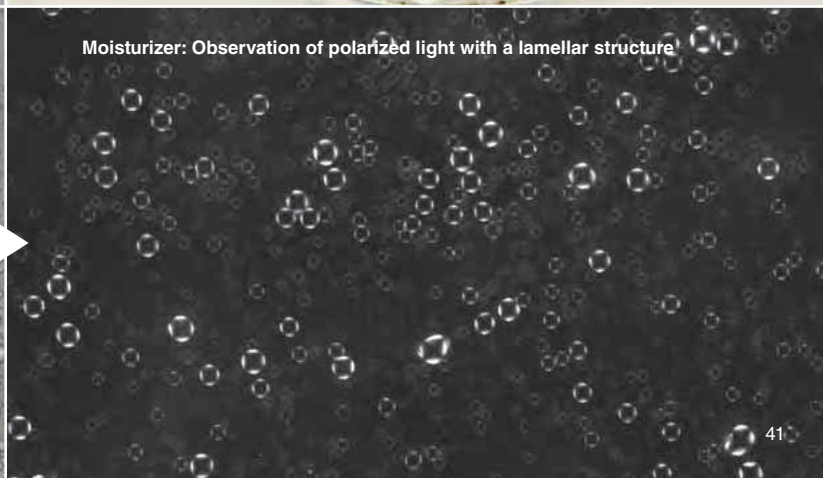



Neurite elongation: Quantitative analysis
with image cytometer
H G F E D C B A
1 2 3 4 5 6 7 8 9 10 11 12


Double emulsion
10 µm


Cortex of hair shaft


Moisturizer: Brightfield


Moisturizer: Observation of polarized light with a lamellar structure

## Specifications of BZ Lens

| | | | | |
|---|---|---|---|---|
| (1) Plan Apochromat 2X | BZ-PA02 | NA 0.10 | WD 8.5 mm 0.33" | |
| (2) Plan Apochromat 4X | BZ-PA04 | NA 0.20 | WD 20.0 mm 0.79" | |
| (3) Plan Apochromat 10X | BZ-PA10 | NA 0.45 | WD 4.0 mm 0.16" | |
| (4) Plan Apochromat 20X | BZ-PA20 | NA 0.75 | WD 0.6 mm 0.02" | |
| (5) Plan Apochromat 40X | BZ-PA40 | NA 0.95 | WD 0.25–0.17 mm 0.010" to 0.007" | |
| (6) Plan Apochromat 60X Oil | BZ-PA60 | NA 1.40 | WD 0.13 mm 0.005" | Oil immersion |
| (7) Plan Apochromat 100X Oil | BZ-PA100 | NA 1.45 | WD 0.13 mm 0.005" | Oil immersion |
| (8) Plan Fluorite 4X PH | BZ-PF04P | NA 0.13 | WD 16.5 mm 0.65" | Phase contrast |
| (9) Plan Fluorite 10X PH | BZ-PF10P | NA 0.30 | WD 14.5 mm 0.57" | Phase contrast |
| (10) Plan Fluorite 20X LD PH | BZ-PF20LP | NA 0.45 | WD 8.8–7.5 mm 0.35" to 0.30" | Phase contrast |
| (11) Plan Fluorite 40X LD PH | BZ-PF40LP | NA 0.60 | WD 3.3–2.2 mm 0.13" to 0.09" | Phase contrast |


## Options

- BZ-X800LE desktop PC **972326**
- Wide monitor **972072**
- Temperature and $CO_2$ regulation chamber (with mixing unit) **972082**
- Temperature and $CO_2$ regulation chamber (for 5% $CO_2$ gas) **972083**
- Immersion oil **971806**

BZ-X blank filter cube
**OP-87767**

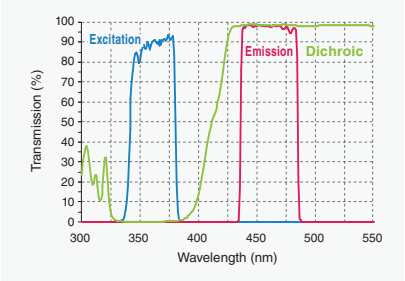
## Specifications of Fluorescence Filter Sets

Units: (nm)

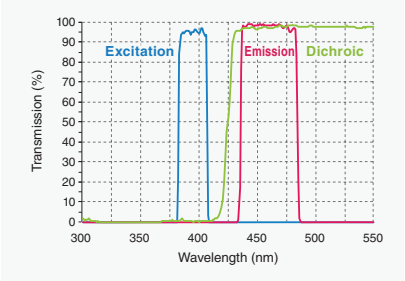
| Set name | Model | Excitation wavelength | Emission wavelength | Dichroic mirror wavelength |
|---|---|---|---|---|
| BZ-X filter DAPI | **OP-87762** | 360/40 | 460/50 | 400 |
| BZ-X filter DAPI-V | **OP-88359** | 395/25 | 460/50 | 425 |
| BZ-X filter GFP | **OP-87763** | 470/40 | 525/50 | 495 |
| BZ-X filter TRITC | **OP-87764** | 545/25 | 605/70 | 565 |
| BZ-X filter TexasRed | **OP-87765** | 560/40 | 630/75 | 585 |
| BZ-X filter Cy5 | **OP-87766** | 620/60 | 700/75 | 660 |

## Spectra of Fluorescence Filters

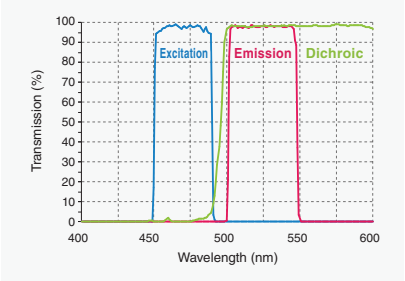
DAPI



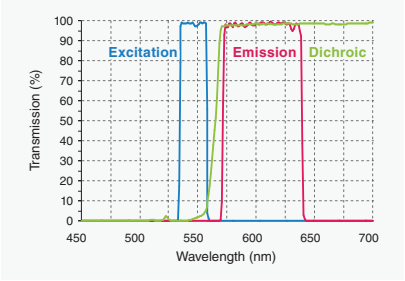

DAPI-V



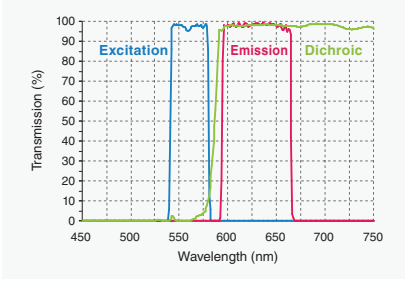

GFP



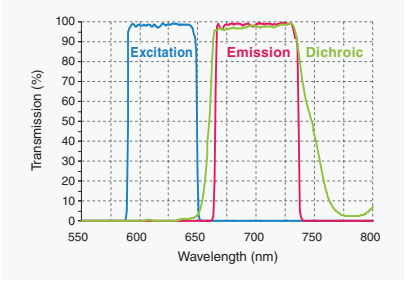

TRITC




TexasRed




Cy5



## Specifications

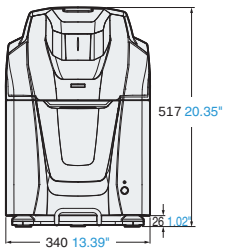
| Model | | BZ-X800LE/BZ-X810 |
|---|---|---|
| Microscope unit | Basic optical system | Inverted fluorescence phase contrast microscope |
| | Objective lenses | BZ Series infinite optical system |
| | Observation modes | Brightfield, Fluorescence (wide-field/sectioning), Phase contrast (PhL, Ph1, Ph2), Oblique illumination |
| | Objective lens switching | Six-mount electronic revolver |
| | Image-formation optical system | Fixed image-forming lens, electronic LC filter insertion/removal mechanism |
| | Motorized XY stage | 114 × 80 mm 4.49" × 3.15" stroke, minimum 1 µm pitch min. |
| | Motorized Z stage | 8 mm 0.31" stroke, minimum 0.1 µm pitch min. |
| | Motorized filter turret | Up to four filters can be mounted. Automatic position recognition and automatic excitation shutdown during filter replacement |
| | Fluorescent incident illumination | Optical sectioning system |
| | Fluorescence dimming mechanism | Electronic dimming (0.3%, 5%, 10%, 20%, 40%, 100%) |
| | Transmitted illumination optical system | Operating distance: 45 mm 1.77", Pop-up mechanism (with automatic lamp shut off function) |
| | Transmitted illumination mechanism | Electronic brightfield aperture (0%, 20%, 40%, 60%, 80%, 100%)/Phase contrast slit (PhL, Ph1, Ph2) |
| | Transmitted light source | 3.7 W LED |
| | Fluorescent light source | 40 W LED |
| | Specimen enclosure | The stage is fully contained in a built-in darkroom |
| Camera unit | Image receiving element | 2/3 inch, 2.83 million pixel monochrome CCD (colorized with LC filter) |
| | CCD cooling mechanism | Peltier cooling: 5°C 41°F (Reduction amount: 25°C 45°F) |
| | Output signal, gradations | 14-bit/8-bit monochrome, 8-bit R/G/B |
| | Frame rate | 15 fps for monochrome recording (up to 95 fps with binning), 8.5 fps for color recording |
| | Binning | On-chip binning (2 × 2, 3 × 3, 4 × 4, 8 × 8, 12 × 12) |
| | Number of pixels in recorded image | 4080 × 3060 max (12.5 megapixel, high-quality interpolation) |
| | Video capture | 8-bit monochrome: 15 fps for 1280 × 960<br>With binning: 29 fps for 960 × 720, 40 fps for 640 × 480, 50 fps for 480 × 360, 75 fps for 240 × 180, 100 fps for 160 × 120<br>Color: 8.5 fps for 1280 × 960 |
| | Electronic shutter | Auto; 1/7500 to 60 sec. (77 increments) |
| | Gain | 0 dB, +6 dB, +12 dB, +18 dB, +24 dB |
| | White balance | Push-set, manual |
| | Black balance | Push-set, manual |
| | Observation software | Multi-color image capturing, Auto focus, Quick full-focusing, Scale display, Electronic revolver control, Electronic stage control |
| Controller | Applicable OS | Windows 10® Professional 64 bit |
| | PC interface | USB2.0 |
| | Ambient temperature | +15 to 35°C 59 to 95°F |
| | Relative humidity | 35 to 80% RH (No condensation) |
| | Dimensions | Head: 517 (H) × 340 (W) × 496 mm (D) 20.35"(H) × 13.39"(W) × 19.53"(D)*1<br>Controller: 227.5 (H) × 125 (W) × 408 mm (D) 8.96"(H) × 4.92"(W) × 16.06"(D) |
| | Weight | Head: Approx. 33 kg 72.75 lb, Controller: Approx. 4.8 kg 10.58 lb |
| | Power supply | 100 to 240 VAC ± 10%, 50/60 Hz |
| | Power consumption | 200 VA or less |
| | Overvoltage category | II |
| | Pollution degree | 2 |
| Functional Modules | BZ-H4XF/Sectioning Module | Optical sectioning image mode |
| | BZ-H4XD/Advanced Observation Module | Navigation, Image stitching, Z-stack, Coordinate-specific condition setting |
| | BZ-H4XI/Image Cytometer Module | Batch capture (user-specified areas/all areas/random areas) *BZ-H4XD required/Image cytometer analysis, batch analysis *BZ-H4C required |
| | BZ-H4XT/Time-lapse Module | Time-lapse imaging, Video capturing, Time-series brightness measurement |
| Analysis Applications | BZ-H4A/Advanced Analysis Software | Image stitching, Haze reduction, Full focus |
| | BZ-H4M/Measurement Application | Dimension measurement, Area measurement, Brightness measurement (line profile, histogram) |
| | BZ-H4R/3D Application | 3D display, 3D measurement, XYZ slicing, Maximum projection, Video saving, (with addition of BZ-H4C) 3D cell count |
| | BZ-H4K/Motion Analysis Application | Motion tracking, Motion analysis, (with addition of BZ-H4C) Time-series cell count |
| | BZ-H4C/Hybrid Cell Count | Cell count (Phase contrast, Brightfield, Fluorescence), Mask cell count |
| | BZ-H4CM/Macro Cell Count | Macro cell count (Batch analysis of multiple images) |

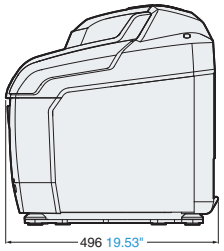
*1 Panel closed • Windows 10® is a registered trademark of Microsoft Corporation in the United States.

## Dimensions

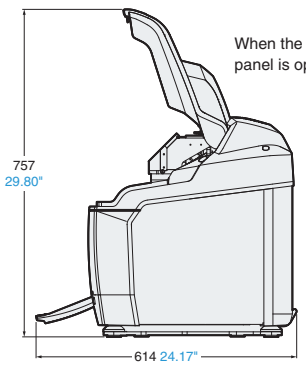
Units: mm inch

Head unit
**BZ-X810**

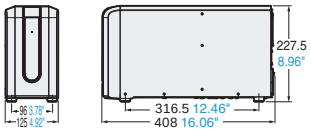



When the panel is open




Controller unit
**BZ-X800LE**



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