

# Apoptosis Detection Guide

Flow Cytometry

Microscopy

Microtiter Plate Assay

Western Blot

Immunohistochemistry



***Enabling Discovery in Life Science®***

## ***ENZO LIFE SCIENCES, INC.***

Enzo Life Sciences, Inc., a subsidiary of Enzo Biochem, Inc., is organized to lead in the development, production, marketing, and sale of innovative life science research reagents worldwide. Now incorporating the skills, experience, and products of ALEXIS Biochemicals, acquired in 2007, BIOMOL International, acquired in 2008, and ASSAY DESIGNS, acquired in 2009, Enzo Life Sciences provides over 25 years of business experience in the supply of research biochemicals, assay systems and biological reagents “Enabling Discovery in Life Science®”.

Based on a very substantial intellectual property portfolio, Enzo Life Sciences, Inc. is a major developer and provider of advanced assay technologies across research and diagnostic markets. A strong portfolio of labeling probes and dyes provides life science environments with tools for target identification and validation, and high content analysis via gene expression analysis, nucleic acid detection, protein biochemistry and detection, molecular biology, and cellular analysis.

- ***Genomic Analysis***
- ***Post-translational Modification***
- ***Cancer & Immunology***
- ***Cellular Analysis***
- ***Signal Transduction***
- ***Drug Discovery***

In addition to our wide range of catalog products, a complementary range of highly specialized custom services are also offered to provide tailor-made solutions for researchers. These include small molecule organic synthesis, peptide synthesis, protein expression, antibody production and immunoassay development.

**International Edition 04/2010**

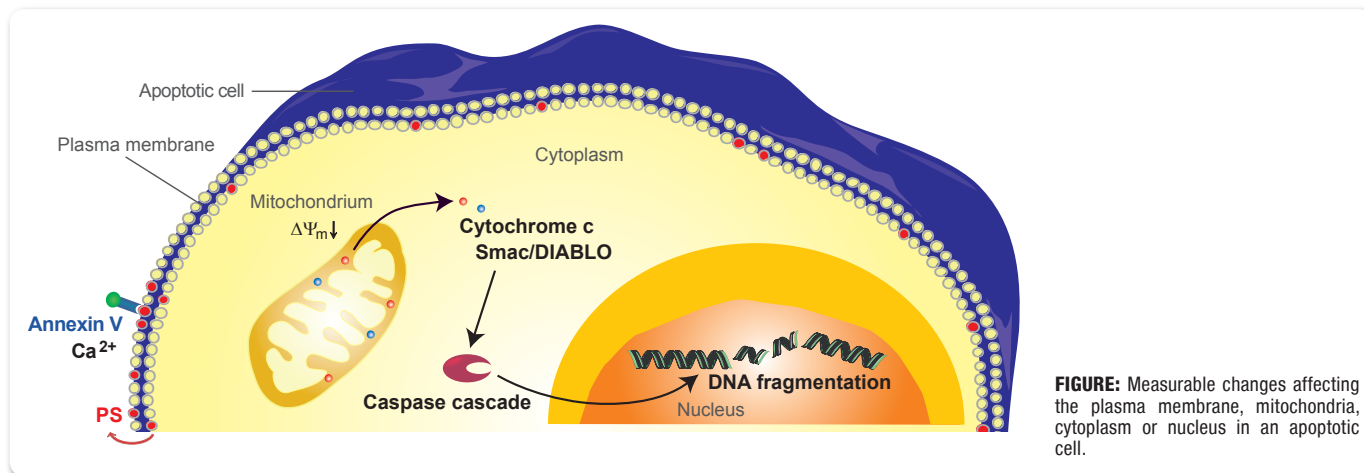
***[www.enzolifesciences.com](http://www.enzolifesciences.com)***

# Introduction

## Apoptosis

Apoptosis is the best-characterized type of programmed cell death. Because of its importance in development & homeostasis and in the pathogenesis of different diseases such as cancer, apoptosis has undergone extensive investigation in the past decades.

During apoptosis cells undergo certain morphological changes such as cell membrane blebbing, cell shrinkage, condensation of the nucleus (pyknosis), nuclear fragmentation (karyorrhexis), and breaking up of the cell into apoptotic bodies. Additionally, several changes affecting the plasma membrane, mitochondria, cytoplasm or nucleus can be measured in apoptotic cells. Depending on the kind of sample to be analyzed and equipment available, a decision tree for selecting appropriate tools for the detection of apoptosis is listed on pages 8/9.



## Apoptosis Detection

### Plasma membrane (PM) Alterations

During the early stages of apoptosis the lipid phosphatidylserine translocates from the inner to the outer leaflet of the plasma membrane. Annexin V is a calcium-dependent protein that preferentially binds phosphatidylserine with high affinity. When conjugated to a fluorescent tag or other reporter, Annexin V can be used to rapidly detect this early cell surface indicator of apoptosis. Although Annexin V is cell-impermeable, false positive can result from necrotic cells which may have holes in the membrane and allow binding to phosphatidylserine on the inner leaflet. Annexin V used in conjunction with a DNA binding dye can be used to distinguish apoptotic (single staining) from necrotic (double staining) cells. During the later stages of apoptosis membrane integrity is lost. Dyes such as 7-Aminoactinomycin D that are normally not capable of passing the plasma membrane of intact cells can be used to distinguish early from late apoptotic cells.

### Mitochondrial Changes

Mitochondrial dysfunction occurs early in apoptosis and is accompanied by a decreased membrane potential. Membrane potential assays test the mitochondria's ability to concentrate a cationic dye using its proton gradient. Loss of mitochondrial membrane potential can lead to apoptosis when the outer mitochondrial membrane ruptures and proteins from the intermembrane space are released into the cytoplasm. The detection of released cytochrome c is specific for early to late stages of apoptosis. Other typical enzymes released from mitochondria during apoptosis include the Bcl-2 family members and Smac/DIABLO.

### Changes in the Cytoplasm

The best characterized change in the cytoplasm during apoptosis is the activation of caspases. They are present in the cytoplasm as latent precursors. Once activated by cleavage, they form dimers, activate other caspases, cleave enzymes and activate endonucleases. This process is known as the caspase cascade. Some caspases (e.g. 2, 8, 9, and 10) initiate apoptosis, others (e.g. 3, 6, and 7) are downstream effectors. Most caspase

assays either rely on cleavage of a specific substrate or on the binding of an irreversible inhibitor. Other assays are based on the caspase specific cleavage of target proteins such as PARP or cytokeratin-18. Some of them specifically detect epitopes revealed only after cleavage by caspases. Caspase assays may detect early to late stages of apoptosis.

Apoptosis is an energy-dependent process that requires ATP. A typical apoptotic cell exhibits a significant decrease in ATP levels. Therefore, the loss of ATP level in a cell can be used as an indicator of cell death. Changes in the ADP/ATP ratio can distinguish the different modes of cell death and viability. Decreased levels of ATP and increased levels of ADP can be seen in apoptotic cells. These changes are much more pronounced in necrosis than in apoptosis. Other features of apoptosis are changes in ion (e.g. zinc) fluxes, which can be detected by specific fluorescent probes.


### DNA Modifications

Chromatin condensation and DNA fragmentation is one of the hallmarks of apoptosis. The DNA from mid to late stage apoptotic cells is more sensitive to heat or formamide denaturation due to changes in chromatin. The resulting ssDNA can be detected by a specific antibody. At the late stage of apoptosis, caspase-activated endonucleases cause double-stranded DNA breaks. These apoptotic nucleosomal fragments (180 - 200 bp) can be resolved by gel electrophoresis as typical DNA ladders. The TUNEL (terminal deoxy-nucleotidyltransferase [TdT] dUTP nick end labelling) assay utilizes TdT to mark those breakpoints with tagged (e.g. biotinylated) nucleotides, which are then detected using enzyme-tagged (for IHC) or fluorescently labelled (for FACS) antibodies. TUNEL indicates DNA cleavage from any form of cell death; necrotic cells may also be labelled. The endonucleases themselves or histone modifications (e.g. phosphorylation of H2AX), which occur during chromatin condensation and DNA fragmentation, can also be detected.

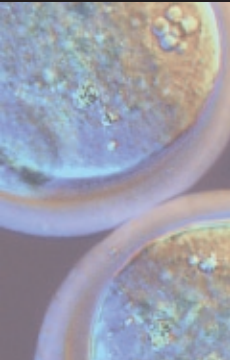
## 01 Intact Cells – Flow Cytometry - PM Alterations

Prod. Name	Prod. No.	Size
Annexin V (human), (rec.)	ALX-201-116-C100	100 µg
Annexin V (human), (rec.) (APC conjugate)	ALX-209-252-T020 ALX-209-252-T100	20 tests 100 tests
Annexin V (human), (rec.) (ATTO 488 conjugate)	ALX-209-258-T100	100 tests
Annexin V (human), (rec.) (ATTO 647N conjugate)	ALX-209-259-T100	100 tests
Annexin V (human), (rec.) (biotin conjugate)	ALX-209-002-T020 ALX-209-002-T100 ALX-209-002-T300	20 tests 100 tests 300 tests
Annexin V (human), (rec.) (FITC conjugate)	ALX-209-250-T020 ALX-209-250-T100 ALX-209-250-T300	20 tests 100 tests 300 tests
Annexin V (human), (rec.) (FITC conjugate)	ALX-209-256-T100 ALX-209-256-3100	100 tests 3 x 100 tests
Annexin V (human), (rec.) (R-PE conjugate)	ALX-209-251-T020 ALX-209-251-T100	20 tests 100 tests
Annexin V (mouse), (rec.) (Alexa Fluor® 488 conjugate)	ALX-209-257-T100	100 tests
Annexin V-Biotin apoptosis detection kit	ALX-850-031-KI02 ALX-850-031-KI01	100 tests 300 tests
Annexin V-Biotin apoptosis detection kit	ALX-850-251-KI01 ALX-850-251-KI02 ALX-850-251-KI03	25 tests 100 tests 400 tests
Annexin V-Cy3 apoptosis detection kit	ALX-850-252-KI01 ALX-850-252-KI02 ALX-850-252-KI03	25 tests 100 tests 400 tests
Annexin V-Cy3 apoptosis detection kit plus	ALX-850-257-KI01 ALX-850-257-KI02	25 tests 100 tests
Annexin V-Cy5 apoptosis detection kit	ALX-850-254-KI01 ALX-850-254-KI02	25 tests 100 tests
Annexin V-EGFP apoptosis detection kit	ALX-850-253-KI01 ALX-850-253-KI02 ALX-850-253-KI03	25 tests 100 tests 400 tests
Annexin V-FITC apoptosis detection kit	ALX-850-020-KI02 ALX-850-020-KI01	100 tests 300 tests
Annexin V-FITC apoptosis detection kit	ALX-850-250-KI01 ALX-850-250-KI02 ALX-850-250-KI03	25 tests 100 tests 400 tests
Annexin V-FITC apoptosis detection kit plus	ALX-850-255-KI01 ALX-850-255-KI02	25 tests 100 tests
Annexin V-FITC kit	ADI-ADK-700-E ADI-ADK-700-F	100 mg 200 mg
Annexin V-PE apoptosis detection kit	ALX-850-256-KI01 ALX-850-256-KI02	25 tests 100 tests
GFP-Certified™ Apoptosis/Necrosis detection kit	ENZ-51002-25 ENZ-51002-100	25 assays 100 assays
Nuclear-ID™ Blue/Green cell viability reagent	ENZ-53004-C100	100 µl
Nuclear-ID™ Blue/Red cell viability reagent (GFP-Certified™)	ENZ-53005-C100	100 µl
Nuclear-ID™ Red/Green cell viability reagent	ENZ-53006-C100	100 µl

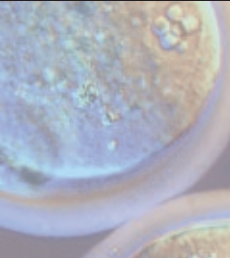
## 02 Intact Cells – Flow Cytometry - Mitochondrial Changes

	Prod. Name	Prod. No.	Size
	DiOC6(3) iodide (ultra pure)	ENZ-52303	100 mg
	JC-1 (ultra pure)	ENZ-52304	5 mg
	JC-10 (ultra pure)	ENZ-52305	5 mg
	Mit-E-Ψ™ Mitochondrial permeability detection kit	BML-AK116-0001	100 tests
	MitoCapture™ Mitochondrial apoptosis detection kit	ALX-850-232-KI01 ALX-850-232-KI02	25 tests 100 tests
	Mito-ID™ Membrane potential detection kit	ENZ-51018-K100	1 Kit

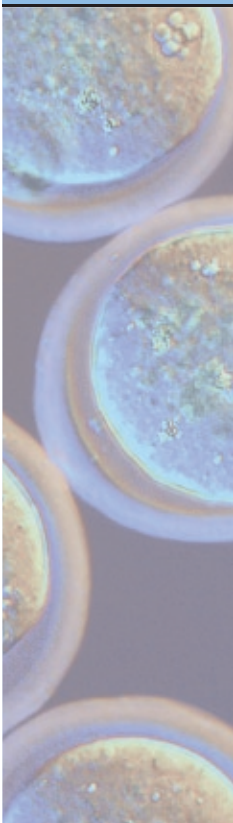
## 03 Intact Cells – Flow Cytometry - Changes in the Cytoplasm

	Prod. Name	Prod. No.	Size
	D <sub>2</sub> R (high purity)	ALX-260-094-M001 ALX-260-094-5001	1 mg 5 x 1 mg
	M30 CytoDEATH™, mAb	ALX-804-590-T200	200 tests
	M30 CytoDEATH™, mAb (Biotin)	ALX-804-590B-T200	200 tests
	M30 CytoDEATH™, mAb (Fluorescein)	ALX-804-590F-T200	200 tests
	M30 CytoDEATH™, mAb (Orange)	ALX-804-590OR-T200	200 tests
	M30 CytoDEATH™, mAb (Red)	ALX-804-590RD-T200	200 tests
	Carboxyfluorescein multi-caspase activity kit	BML-AK117-0001	1 Kit
	CaspSCREEN™ flow cytometric apoptosis detection kit	ALX-850-244-KI01 ALX-850-244-KI02	25 tests 100 tests
	CV-Caspase-3 & -7 detection kit	BML-AK118-0001	1 Kit
	Sulforhodamine multi-caspase activity kit	BML-AK115-0001	100 tests

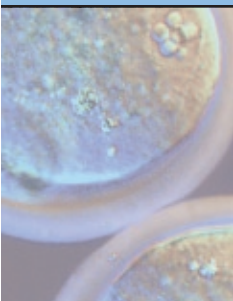
## 04 Intact Cells – Flow Cytometry - DNA Modifications

	Prod. Name	Prod. No.	Size
	7-Aminoactinomycin D	BML-AP400-0001	1 mg
	Propidium Iodide (ultra pure)	ENZ-52403	100 mg
	ssDNA, mAb (F7-26)	ALX-804-192-R200 ALX-804-192-L001	200 µl 1 ml
	APO-BRDU™ kit	ALX-850-042-KI01	1 Kit
	APO-DIRECT™ kit	ALX-850-041-KI01	1 Kit
	Nuclear-ID™ Green chromatin condensation detection kit	ENZ-51021-K200	1 Kit


## 05 Intact Cells – Microscopy - PM Alterations

	Prod. Name	Prod. No.	Size
	Annexin V (human), (rec.)	ALX-201-116-C100	100 µg
	Annexin V (human), (rec.) (ATTO 488 conjugate)	ALX-209-258-T100	100 tests
	Annexin V (human), (rec.) (ATTO 647N conjugate)	ALX-209-259-T100	100 tests
	Annexin V-Biotin apoptosis detection kit	ALX-850-251-KI01 ALX-850-251-KI02 ALX-850-251-KI03	25 tests 100 tests 400 tests
	Annexin V-Cy3 apoptosis detection kit	ALX-850-252-KI01 ALX-850-252-KI02 ALX-850-252-KI03	25 tests 100 tests 400 tests
	Annexin V-Cy3 apoptosis detection kit plus	ALX-850-257-KI01 ALX-850-257-KI02	25 tests 100 tests
	Annexin V-Cy5 apoptosis detection kit	ALX-850-254-KI01 ALX-850-254-KI02	25 tests 100 tests
	Annexin V-EGFP apoptosis detection kit	ALX-850-253-KI01 ALX-850-253-KI02 ALX-850-253-KI03	25 tests 100 tests 400 tests
	Annexin V-FITC apoptosis detection kit	ALX-850-250-KI01 ALX-850-250-KI02 ALX-850-250-KI03	25 tests 100 tests 400 tests
	Annexin V-FITC kit	ADI-ADK-700-E ADI-ADK-700-F	100 mg 200 mg
	Annexin V-PE apoptosis detection kit	ALX-850-256-KI01 ALX-850-256-KI02	25 tests 100 tests
	GFP-Certified™ Apoptosis/Necrosis detection kit	ENZ-51002-25 ENZ-51002-100	25 assays 100 assays
	Nuclear-ID™ Blue/Green cell viability reagent	ENZ-53004-C100	100 µl
	Nuclear-ID™ Blue/Red cell viability reagent (GFP-Certified™)	ENZ-53005-C100	100 µl
	Nuclear-ID™ Red/Green cell viability reagent	ENZ-53006-C100	100 µl


## 06 Intact Cells – Microscopy - Mitochondrial Changes

	Prod. Name	Prod. No.	Size
	DiOC6(3) iodide (ultra pure)	ENZ-52303	100 mg
	Rhodamine 123 (ultra pure)	ENZ-52307	25 mg
	Cytochrome c, mAb (6H2.B4)	ADI-905-634-100	100 µg
	Smac/DIABLO (human), mAb (10G7)	ALX-804-333-C100	100 µg
	Mit-E-Ψ™ Mitochondrial permeability detection kit	BML-AK116-0001	100 tests
	MitoCapture™ Mitochondrial apoptosis detection kit	ALX-850-232-KI01 ALX-850-232-KI02	25 tests 100 tests
	Mito-ID™ Membrane potential detection kit	ENZ-51018-K100	1 Kit


## 07 Intact Cells – Microscopy - Changes in the Cytoplasm

	Prod. Name	Prod. No.	Size
	D <sub>2</sub> R (high purity)	ALX-260-094-M001 ALX-260-094-5001	1 mg 5 x 1 mg
	Zinquin ethyl ester (ultra pure)	ENZ-52151	5 mg
	Zinquin free acid (ultra pure)	ENZ-52152	5 mg
	M30 CytoDEATH™, mAb	ALX-804-590-T200	200 tests
	M30 CytoDEATH™, mAb (Biotin)	ALX-804-590B-T200	200 tests
	M30 CytoDEATH™, mAb (Fluorescein)	ALX-804-590F-T200	200 tests
	M30 CytoDEATH™, mAb (Orange)	ALX-804-590OR-T200	200 tests
	M30 CytoDEATH™, mAb (Red)	ALX-804-590RD-T200	200 tests
	Carboxyfluorescein multi-caspase activity kit	BML-AK117-0001	1 Kit
	CV-Caspase-3 & -7 detection kit	BML-AK118-0001	1 Kit
	Sulforhodamine multi-caspase activity kit	BML-AK115-0001	100 tests

## 08 Intact Cells – Microscopy - DNA Modifications

	Prod. Name	Prod. No.	Size
	7-Aminoactinomycin D	BML-AP400-0001	1 mg
	Propidium Iodide (ultra pure)	ENZ-52403	100 mg
	ssDNA, mAb (F7-26)	ALX-804-192-R200 ALX-804-192-L001	200 µl 1 ml
	[pSer <sup>139</sup> ]Histone γ-H2AX (human), pAb	ALX-210-390-R050	50 µl
	APO-BRDU™ kit	ALX-850-042-KI01	1 Kit
	APO-DIRECT™ kit	ALX-850-041-KI01	1 Kit
	Comet SCGE assay kit	ADI-900-166	1 Kit
	Nuclear-ID™ Green chromatin condensation detection kit	ENZ-51021-K200	1 Kit


## 09 Intact Cells – Microtiter Plate Assay – Mitochondrial Changes

	Prod. Name	Prod. No.	Size
	Mit-E-Ψ™ Mitochondrial permeability detection kit	BML-AK116-0001	100 tests
	Mito-ID™ Membrane potential cytotoxicity kit	ENZ-51019-KP002	1 Kit

## 10 Intact Cells – Microtiter Plate Assay – Changes in the Cytoplasm

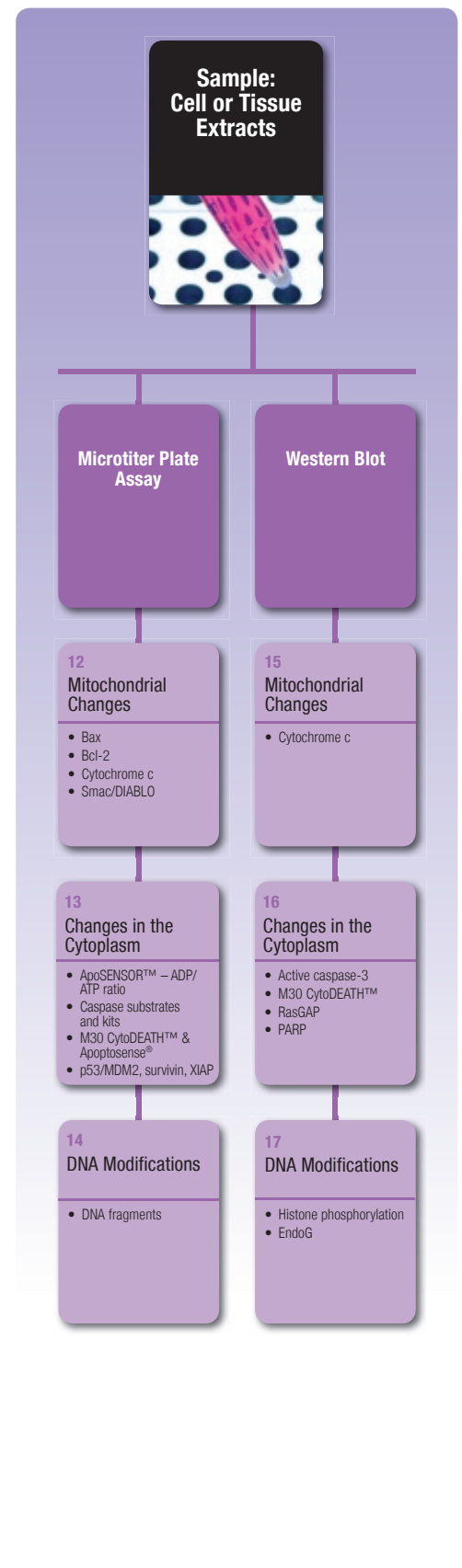
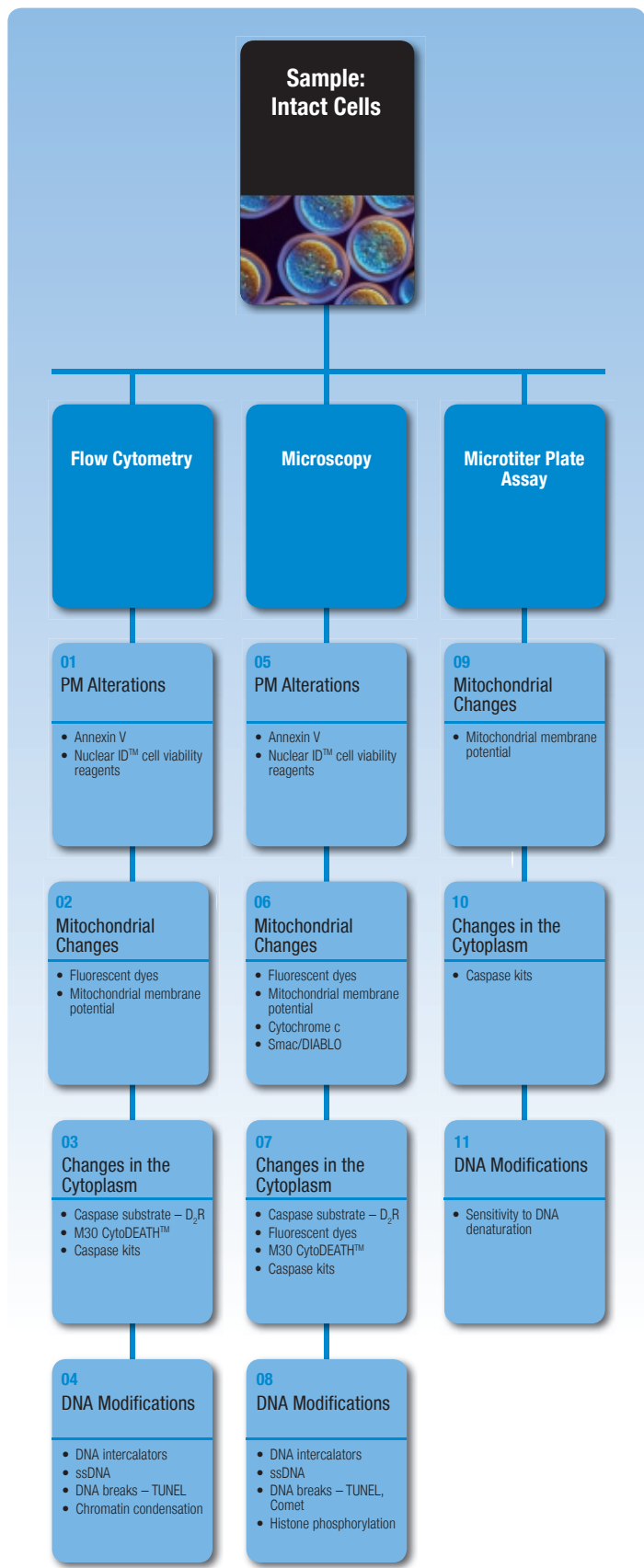
	Prod. Name	Prod. No.	Size
	Carboxyfluorescein multi-caspase activity kit	BML-AK117-0001	1 Kit
	CV-Caspase-3 & -7 detection kit	BML-AK118-0001	1 Kit
	Sulforhodamine multi-caspase activity kit	BML-AK115-0001	100 tests

## 11 Intact Cells – Microtiter Plate Assay – DNA Modifications

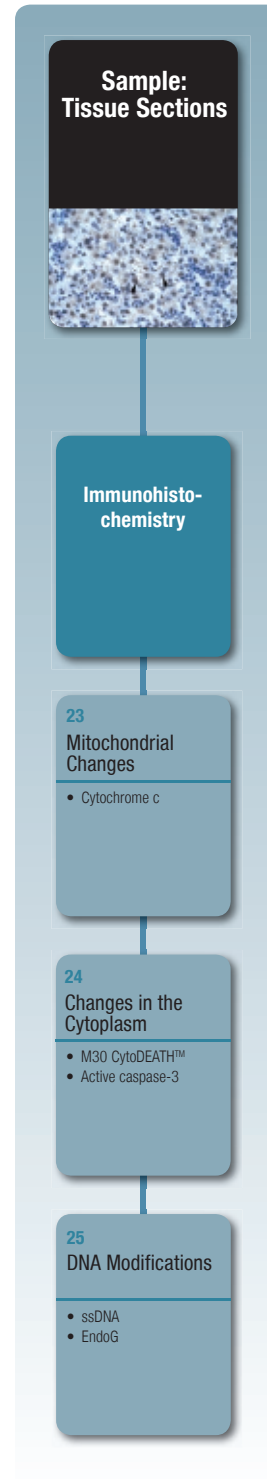
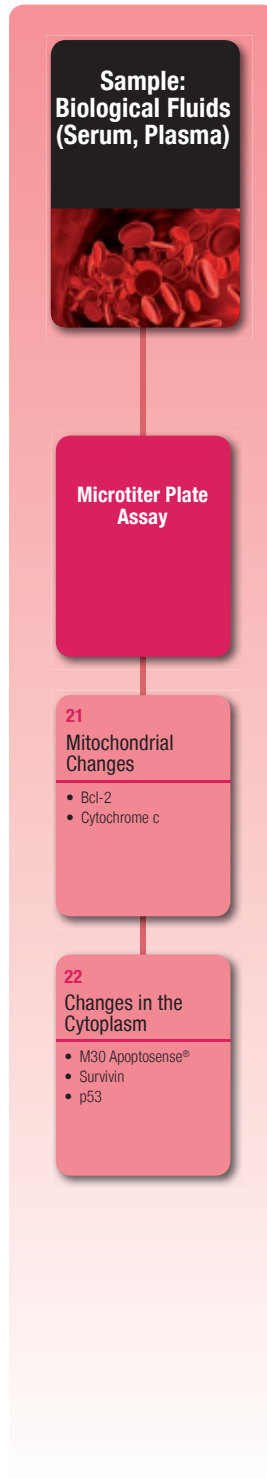
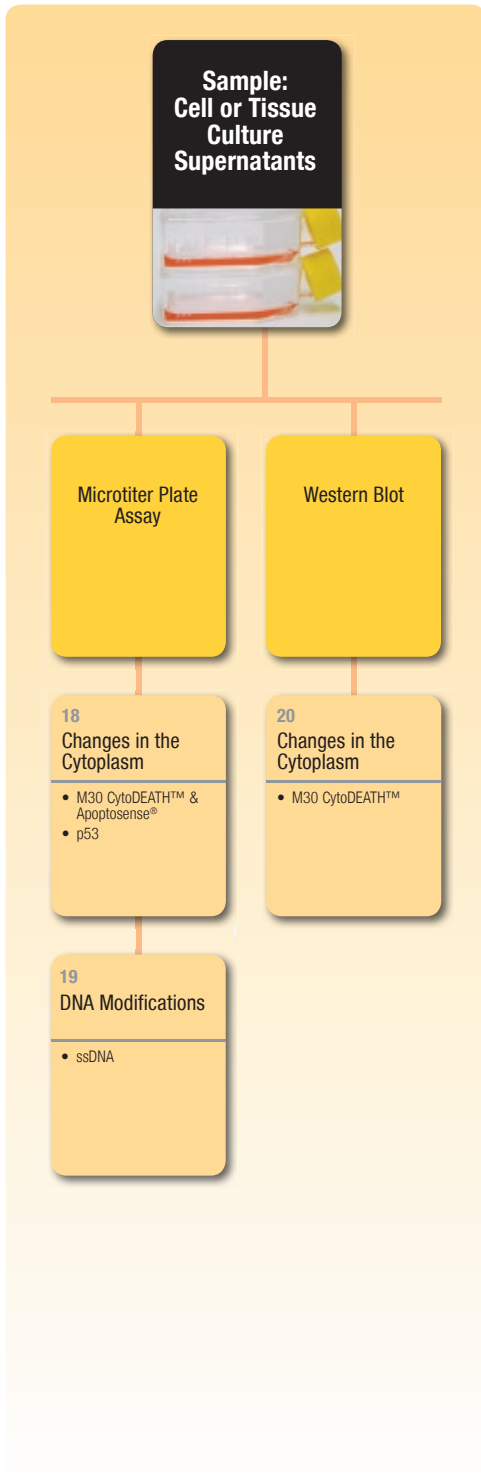
	Prod. Name	Prod. No.	Size
	ApoStrand™ ELISA apoptosis detection kit	BML-AK120-0001	1 Kit

Sample and Detection Method

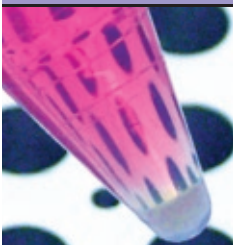
Parameter to be Analyzed








## 12 Cell or Tissue Extracts – Microtiter Plate Assay – Mitochondrial Changes



Prod. Name	Prod. No.	Size
Bax (human), EIA kit	ADI-900-138	96 wells
Bcl-2 (human), EIA kit	ADI-900-133	96 wells
Bcl-2 (human) ELISA kit	ALX-850-056-KI01	1 Kit
Cytochrome c (human) ELISA kit	ALX-850-261-KI01	1 Kit
Cytochrome c (human), EIA kit	ADI-900-141	96 wells
Smac/DIABLO (human), EIA kit	ADI-900-125	96 wells

## 13 Cell or Tissue Extracts – Microtiter Plate Assay – Changes in the Cytoplasm



Prod. Name	Prod. No.	Size
ApoSENSOR™ ADP/ATP ratio assay kit	ALX-850-248-KI01	200 tests
ApoSENSOR™ Cell viability assay kit	ALX-850-247-KI01	200 tests
Caspase colorimetric quantipak	BML-AK004-0001	1 Kit
Caspase colorimetric substrate set	ALX-850-228-KI01	1 Set
Caspase colorimetric substrate set plus	ALX-850-274-KI01	1 Set
Caspase fluorescent (AFC) quantipak	BML-AK006-0001	1 Kit
Caspase fluorescent (AMC) quantipak	BML-AK005-0001	1 Kit
Caspase fluorometric substrate set	ALX-850-229-KI01	1 Set
Caspase fluorometric substrate set plus	ALX-850-275-KI01	1 Set
Caspase-1 colorimetric assay kit	ALX-850-211-KI01	25 tests
Caspase-1 fluorometric assay kit	ALX-850-212-KI01	25 tests
Caspase-2 colorimetric assay kit	ALX-850-213-KI01	25 tests
Caspase-2 fluorometric assay kit	ALX-850-214-KI01	25 tests
Caspase-3 cell assay kit	BML-AK703-0001	1 Kit
Caspase-3 colorimetric assay kit	ALX-850-215-KI01	25 tests
Caspase-3 colorimetric detection kit	ADI-907-013	96 wells
Caspase-3 fluorometric assay kit	ALX-850-216-KI01	25 tests
Caspase-3 fluorometric detection kit	ADI-907-014	96 wells
Caspase-5 colorimetric assay kit	ALX-850-217-KI01	25 tests
Caspase-5 fluorometric assay kit	ALX-850-218-KI01	25 tests
Caspase-6 colorimetric assay kit	ALX-850-219-KI01	25 tests
Caspase-6 fluorometric assay kit	ALX-850-220-KI01	25 tests
Caspase-8 colorimetric assay kit	ALX-850-221-KI01	25 tests
Caspase-8 fluorometric assay kit	ALX-850-222-KI01	25 tests
Caspase-9 colorimetric assay kit	ALX-850-223-KI01	25 tests
Caspase-9 fluorometric assay kit	ALX-850-224-KI01	25 tests
ImmunoSet™ p53/MDM2 complex ELISA development set	ADI-960-070	5 x 96 wells
M30 CytoDeath™ ELISA kit	ALX-850-336-KI01	1 Kit
M30-Apoptosense® ELISA kit	ALX-850-270-KI01 ALX-850-270-5001	1 Kit 5 x 1 Kit
[pSer <sup>218</sup> /Ser <sup>222</sup> ]MEK1 EIA kit	ADI-900-119	96 wells
p53 EIA kit	ADI-900-117	96 wells
PKC kinase activity kit	ADI-EKS-420A	96 wells
Ras activation kit	ADI-EKS-460	1 Kit
Survivin (human), EIA kit	ADI-900-111	96 wells
XIAP (human), EIA kit	ADI-900-124	96 wells

#### 14 Cell or Tissue Extracts – DNA Agarose Gel – DNA Modifications

Prod. Name	Prod. No.	Size
Quick apoptotic DNA ladder detection kit	ALX-850-242-KI01	1 Kit

#### 15 Cell or Tissue Extracts – Western Blot – Mitochondrial Changes

Prod. Name	Prod. No.	Size
Cytochrome c, mAb (7H8.2C12)	ADI-AAM-175-E	100 µg
Cytochrome c, mAb (CTC05)	BML-SA226-0500	500 µl
Cytochrome c releasing apoptosis assay kit	ALX-850-277-KI01	1 Kit


#### 16 Cell or Tissue Extracts – Western Blot – Changes in the Cytoplasm

Prod. Name	Prod. No.	Size
Caspase-3, mAb (31A1067)	ALX-804-305-C100	100 µg
M30 CytoDEATH™, mAb	ALX-804-590-T200	200 tests
M30 CytoDEATH™, mAb (Biotin)	ALX-804-590B-T200	200 tests
Caspase-3 (active), pAb	ALX-210-807-C100	100 µg
Caspase-3, pAb	ALX-210-806-C100	100 µg
PARP-1, mAb (F1-23)	ALX-804-211-R050	50 µl
PARP-1, mAb (C-2-10) (affinity purified)	BML-SA249-0100	100 µg
PARP-1 (1-232) (human), pAb	ALX-210-771-1	1 Vial
PARP-1 (197-214), pAb	ALX-210-219-R100	100 µl
PARP-1, pAb	ALX-210-302-R100	100 µl
RasGAP (CT), pAb	ALX-210-781-R100	100 µl
RasGAP (NT), pAb	ALX-210-860-R100	100 µl
PARP cleavage Western blotting kit	BML-SK003-0001	1 Kit

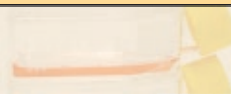
#### 17 Cell or Tissue Extracts – Western Blot – DNA Modifications

Prod. Name	Prod. No.	Size
[pSer <sup>139</sup> ]Histone H2AX, mAb (9F3)	ADI-KAM-CC255-D	50 µg
	ADI-KAM-CC255-F	200 µg
EndoG, pAb	ADI-905-220-100	100 µg
[pSer <sup>139</sup> ]Histone H2AX, pAb	ADI-905-771-100	100 µg
[pSer <sup>139</sup> ]Histone γ-H2AX (human), pAb	ALX-210-390-R050	50 µl


### 18 Cell or Tissue Culture Supernatants – Microtiter Plate Assay – Changes in the Cytoplasm

	Prod. Name	Prod. No.	Size
	M30 CytoDeath™ ELISA kit	ALX-850-336-KI01	1 Kit
	M30-Apoptosense® ELISA kit	ALX-850-270-KI01 ALX-850-270-5001	1 Kit 5 x 1 Kit
	p53 (human) ELISA kit	ALX-850-057-KI01	1 Kit


### 19 Cell or Tissue Culture Supernatants – Microtiter Plate Assay – DNA Modifications

	Prod. Name	Prod. No.	Size
	ssDNA, mAb (F7-26)	ALX-804-192-R200 ALX-804-192-L001	200 µl 1 ml

### 20 Cell or Tissue Culture Supernatants – Western Blot – Changes in the Cytoplasm

	Prod. Name	Prod. No.	Size
	M30 CytoDEATH™, mAb	ALX-804-590-T200	200 tests
	M30 CytoDEATH™, mAb (Biotin)	ALX-804-590B-T200	200 tests

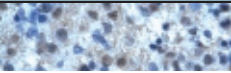
### 21 Biological Fluids (Serum, Plasma) – Microtiter Plate Assay – Mitochondrial Changes

	Prod. Name	Prod. No.	Size
	Bcl-2 (human) ELISA kit	ALX-850-056-KI01	1 Kit
	Cytochrome c, mAb (6H2.B4)	ADI-905-634-100	100 µg

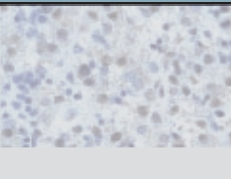
### 22 Biological Fluids (Serum, Plasma) – Microtiter Plate Assay – Changes in the Cytoplasm

	Prod. Name	Prod. No.	Size
	M30-Apoptosense® ELISA kit	ALX-850-270-KI01 ALX-850-270-5001	1 Kit 5 x 1 Kit
	Survivin (human), EIA kit	ADI-900-111	96 wells
	p53 EIA kit	ADI-900-117	96 wells
	p53 (human) ELISA kit	ALX-850-057-KI01	1 Kit

### 23 Tissue Sections – Immunohistochemistry – Mitochondrial Changes

	Prod. Name	Prod. No.	Size
	Cytochrome c, mAb (6H2.B4)	ADI-905-634-100	100 µg

### 24 Tissue Sections – Immunohistochemistry – Changes in the Cytoplasm

	Prod. Name	Prod. No.	Size
	M30 CytoDEATH™, mAb	ALX-804-590-T200	200 tests
	M30 CytoDEATH™, mAb (Biotin)	ALX-804-590B-T200	200 tests
	M30 CytoDEATH™, mAb (Fluorescein)	ALX-804-590F-T200	200 tests
	M30 CytoDEATH™, mAb (Orange)	ALX-804-590OR-T200	200 tests
	M30 CytoDEATH™, mAb (Red)	ALX-804-590RD-T200	200 tests
	Caspase-3 (active), pAb	ALX-210-807-C100	100 µg

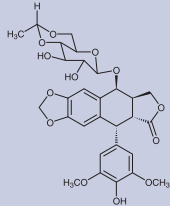
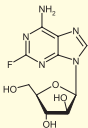

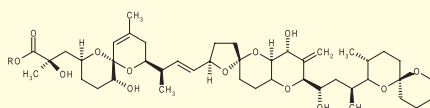
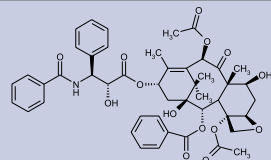
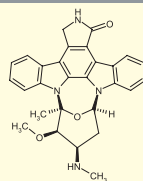
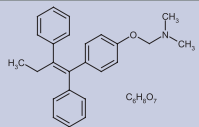
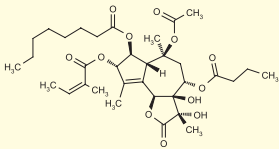
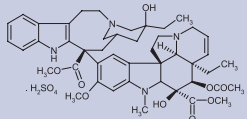
### 25 Tissue Sections – Immunohistochemistry – DNA Modifications

	Prod. Name	Prod. No.	Size
	ssDNA, mAb (F7-26)	ALX-804-192-R200 ALX-804-192-L001	200 µl 1 ml
	EndoG, pAb	ADI-905-220-100	100 µg

# Apoptosis Inducers

Apoptosis is a normal cellular process induced by various extrinsic or intrinsic signaling pathways. Several agents can be used to induce apoptosis experimentally, the most common ones are listed below.

Product	Prod. No.	Size
<b>Actinomycin D</b>	BML-GR300-0005	5 mg
<b>AG-490</b>	BML-EI272-0010 BML-EI272-0050	10 mg 50 mg
<b>Anisomycin</b>	BML-ST102-0010 BML-ST102-0050	10 mg 50 mg
<b>Betulinic acid (high purity)</b>	ALX-350-277-M005 ALX-350-277-M025 ALX-350-277-M100	5 mg 25 mg 100 mg
<b>Brefeldin A</b>	BML-G405-0005 BML-G405-0025 BML-G405-0100	5 mg 25 mg 100 mg
<b>(S)-(+)-Camptothecin</b>	ALX-350-015-M050 ALX-350-015-M250 ALX-350-015-G001	50 mg 250 mg 1 g
<b>Colchicine</b>	ALX-380-033-G001	1 g
<b>Cycloheximide</b>	ALX-380-269-G001 ALX-380-269-G005	1 g 5 g
<b>Daunorubicin . hydrochloride</b>	ALX-380-043-M010	10 mg
<b>Dexamethasone</b>	BML-EI126-0001 BML-EI126-0005	1 g 5 g
<b>Doxorubicin . hydrochloride</b>	BML-GR319-0005 BML-GR319-0025	5 mg 25 mg

Product	Prod. No.	Size
<b>Etoposide</b> 	BML-GR307-0100	100 mg
	BML-GR307-0500	500 mg
<b>Fludarabine</b> 	ALX-480-100-M005	5 mg
	ALX-480-100-M025	25 mg
<b>5-Fluorouracil</b> 	ALX-480-099-G001	1 g
	ALX-480-099-G005	5 g
<b>Okadaic acid (high purity)</b> 	ALX-350-003-C025	25 µg
	ALX-350-003-C050	50 µg
	ALX-350-003-C100	100 µg
	ALX-350-003-M001	1 mg
<b>Paclitaxel</b> 	BML-T104-0005	5 mg
	BML-T104-0025	25 mg
	BML-T104-0250	250 mg
<b>Staurosporine</b> 	ALX-380-014-C100	100 µg
	ALX-380-014-C250	250 µg
	ALX-380-014-M001	1 mg
	ALX-380-014-M005	5 mg
	BML-EI156-0100	100 µg
BML-EI156-1000	1 mg	
<b>Tamoxifen . citrate</b> 	ALX-550-095-G001	1 g
<b>Thapsigargin</b> 	BML-PE180-0001	1 mg
	BML-PE180-0005	5 mg
<b>Vinblastine . sulfate</b> 	ALX-350-257-M005	5 mg
	ALX-350-257-M025	25 mg

# International Distributors

## Argentina

**LAB SCIENTIFIC, INC. (USA)**  
Tel: (305) 716-9922  
Fax: (305) 716-9923  
E-mail: labscientific@labscient.com

## Australia

**SAPPHIRE BIOSCIENCE Pty. Ltd.**  
Tel: +61 (0) 2 9698 2022  
Fax: +61 (0) 2 9698 1022  
E-mail: sales@sapphirebioscience.com

**UNITED BIOWESEARCH PRODUCTS**  
Tel: +61 (0) 2 9651 3736  
Fax: +61 (0) 2 9651 4247  
E-mail: kirrily@unitedbiowearch.com.au

## Austria

**EUBIO**  
Tel: (0)1 89 50 145  
Fax: (0)1 89 50 145-14  
E-mail: koeck@eubio.at

## Bangladesh

**FUTURE BUSINESS VISION**  
Tel: (0)2 8631173  
Fax: (0)2 8651847  
E-mail: salam.fbv@gmail.com

## Belarus

**CHIMMED Inc.**  
Tel: +7 095 728 4192  
Fax: +7 095 742 8341  
E-mail: bio@chimmed.ru

## Belgium

**ENZO LIFE SCIENCES BVBA**  
Tel: +32 (0) 3 466 04 20  
Fax: +32 (0) 3 466 04 29  
E-mail: info-be@enzolifesciences.com

## Bosnia and Herzegovina

**A-Ž LAB D.O.O.**  
Tel: +386 (0)1 433 63 22 / +386 (0)1 230 18 84  
Fax: +386 (0)1 230 19 85  
E-mail: az.consulting@siol.net

## Brazil

**LGC BIOTECHNOLOGIA**  
Tel: (0)21 2583 4268 / (0)21 3273 5828  
Fax: (0)21 3273 5896  
E-mail: info@lgcbio.com.br

**SELLEX S.A.C.**  
Tel: (0)11 5506 4646  
Fax: (0)11 5507 4204  
E-mail: vendas@sellex.com

## Canada

**ENZO LIFE SCIENCES INTERNATIONAL, INC.**  
Tel: (610) 941-0430  
Toll Free Tel: 1-800-942-0430  
Fax: (610) 941-9252  
E-mail: info-usa@enzolifesciences.com

**CEDARLANE LABORATORIES**  
Tel: (289) 288-0001  
Toll Free: 1-800-269-5058  
Fax: (289) 288-0020  
Toll Free: 1-800-638-5099  
E-mail: general@cedarlanelabs.com

**\*\*BioLynx Inc.**  
Tel: (613) 498-2126  
Toll Free: 1-888-593-5969  
Fax: (613) 342-1341  
E-mail: tech@biolynx.ca

## Chile

**BIOCANT Ltda.**  
Tel: (0)2 683 2437  
Fax: (0)56 2 683 8823  
E-mail: info@biocant.cl

**GENE X-PRESS**  
Tel: +56-2-224-2746  
Fax: +56-2-220-8203  
E-mail: dmihovl@genex.ti.cl

## China

**BEIJING BITAB BIOTECH Co. Ltd.**  
Tel: (0)10 8201 5225  
Fax: (0)10 6201 5131  
E-mail: info@bitabo.com

**BOPPARD**  
Tel: (0)21 6288 4751 (SH)  
Tel: (0)20 8732 6381 (GZ)  
Fax: (0)21 6288 4752 (SH)  
Fax: (0)20 8732 6382 (GZ)  
E-mail: info@boppar.com

**GENETIMES TECHNOLOGY Inc.**  
Tel: (0)21 5426 2677  
Fax: (0)21 6439 8855  
E-mail: order@genetimes.com.cn

## ITS CHINA

Tel: (0)21 648 144 28/98  
Fax: (0)21 643 93402  
E-mail: info@its-science-china.com

## KANGCHEN BIO-TECH

Tel: (0)21 6455 1989  
Toll Free: 800 820 5058 (China only)  
Fax: (0)21 6455 2021  
E-mail: order@kangchen.com.cn

**MULTISCIENCES BIOTECH Co. Ltd.**  
Tel: (0)571 8816 3301  
Toll Free: (0)800 8571 184  
Fax: (0)571 8816 3303  
E-mail: service@gotof.com

**NEOBIOGENE TECHNOLOGY**  
Tel: (0)755 26 755 677  
Toll Free: 8008306982  
Fax: (0)755 26 755 877  
E-mail: info@neobiogene.com

**TWC BIOWESEARCH INTERNATIONAL**  
Tel: (0)852 2649 9988  
Fax: (0)852 2635 0379  
E-mail: support@twcbiowearch.com

## Colombia

**LAB SCIENTIFIC, INC. (USA)**  
Tel: (305) 716-9922  
Fax: (305) 716-9923  
E-mail: labscientific@labscient.com

## Cyprus

**SB BIOTECHNOLOGY SUPPLIERS SA**  
Tel: +30 210 823 3373 / +30 210 691 0148  
Fax: +30 210 825 9987  
E-mail: info@sbbiotech.gr

## Czech Republic

**GENETICA s.r.o.**  
Tel: +420 2 7270 1055  
Fax: +420 2 7270 1739  
E-mail: genetika@genetica.cz

## Denmark

**SMS GRUPPEN**  
Tel: (0)4586 4400  
Fax: (0)4586 4881  
E-mail: mail@sms-gruppen.dk

## Ecuador

**LAB SCIENTIFIC, INC. (USA)**  
Tel: (305) 716-9922  
Fax: (305) 716-9923  
E-mail: rshlesinger@labscient.com

## Egypt

**NEW TEST Co. (NTCo)**  
Tel: (0)3544 4736  
Fax: (0)3559 6836  
E-mail: info@newtest.com.eg

## Estonia

**IN VITRO EESTI OÜ**  
Tel: +372 630 65 20  
Fax: +372 630 65 22  
E-mail: info@invitro.ee

**FINLAND**  
**NUPPINLINN LABORATORIOPALVELU OY**  
Tel: (0)20 792 0350  
Fax: (0)20 792 0351  
E-mail: nuppinlinna@dlc.fi

## France

**ENZO LIFE SCIENCES FRANCE**  
c/o Covalab s.a.s  
Tel: +33(0) 472 440 655  
Fax: +33(0) 437 484 239  
E-mail: info-fr@enzolifesciences.com

## Germany

**ENZO LIFE SCIENCES GmbH**  
Tel: (0)7621 5500 522  
Toll Free 8000 253 9472  
Fax: (0)7621 5500 527  
E-mail: info-de@enzolifesciences.com

## Greece

**SB BIOTECHNOLOGY SUPPLIERS SA**  
Tel: +30 210 823 3373 / +30 210 691 0148  
Fax: +30 210 825 9987  
E-mail: info@sbbiotech.gr

## Hong Kong

**BOPPARD (H.K.) Co. Ltd**  
Tel: +852 2799 9019  
Fax: +852 2799 9808  
E-mail: info@boppar.com.hk

## Hungary

**BIOMARKER Ltd**  
Tel: (0)28 419 986  
Fax: (0)28 422 319  
E-mail: biomarker@biomarker.hu

## India

**HYSEL INDIA Pvt. Ltd.**  
Tel: (0)11 2622 7801/02/03/04  
Fax: (0)11 2622 7805  
E-mail: hysel@del2.vsnl.net.in

**GAURAV ENTERPRISE (AGRA)**  
Tel: (0)562 288 3724  
Fax: (0)562 288 1414  
E-mail: girish640@yahoo.co.in

**LABEX CORPORATION**  
Tel: (0)11 2612 4727 / (0)11 2613 5922 / (0)11 41771988  
Toll Free: 8008306982  
Fax: (0)11 2612 4735 / (0)11 2689 3172  
E-mail: labex@labex.net

**PRO LAB MARKETING Pvt. Ltd.**  
Tel: (0)11 6660 7726 / (0)11 6565 2166  
Fax: (0)11 6660 7726 / (0)11 4165 8854  
E-mail: info@prolabmarketing.com

## Indonesia

**ITS INDONESIA**  
Tel: (0)21 451 6222  
Fax: (0)21 451 6223  
E-mail: info@its-indonesia.com

## Iran

**HORMOZ PAJAHAN LAB. EQUIPMENT Ltd.**  
Tel: (0)21 8888 3444  
Fax: (0)21 8877 0192  
E-mail: ahmadi@hermes-pajahan.com

## Iraq

**IRAQ HEART Co. Ltd.**  
Tel: (0)790 171 7504  
Cell: (0)770 278 7372 / (0)780 780 9800  
E-mail: mailthem\_jhsan@yahoo.com

## Ireland

**ENZO LIFE SCIENCES (UK) LTD.**  
Tel: 0845 601 1488 / +44(0) 1392 825900  
Fax: +44(0) 1392 825910  
E-mail: info-uk@enzolifesciences.com

## Israel

**ALMOG DIAGNOSTIC & MEDICAL EQUIPMENT Ltd.**  
Tel: (0)3977 3390  
Fax: (0)3977 3391  
E-mail: info@almog.co.il

**GADOT LABORATORY SUPPLY Ltd.**  
Tel: (0)5075 222 49  
Toll Free: 1 800 20 22 20 (Israel Only)  
Fax: 1 800 300 707  
E-mail: galitd@gadot.com

## Italy

**VINCI-BIOCHEM**  
Tel: (0)571 568 147  
Fax: (0)571 568 132  
E-mail: vb@vincibiotech.it

## Japan

**BIOLINKS K.K.**  
Tel: (0)3 5443 6891  
Fax: (0)3 5443 0271  
E-mail: info@biolinks.co.jp

**COSMO BIO Co. Ltd.**  
Tel: (0)3 5632 9610  
Fax: (0)3 5632 9619  
E-mail: mail@cosmobio.co.jp

**FUNAKOSHI Co., Ltd.**  
Tel: (0)3 5684 1620  
Fax: (0)3 5684 1775  
E-mail: reagent@funakoshi.co.jp

## Kazakhstan

**CHIMMED Inc.**  
Tel: +7 095 728 4192  
Fax: +7 095 742 8341  
E-mail: bio@chimmed.ru

## Korea, South

**CHUN YANG TECH**  
Tel: +82 32 624 0160  
Fax: +82 32 624 0163  
E-mail: 123ky@naver.com

**SERVLAB CO.**  
Tel: +82 2 449 8787  
Fax: +82 2 499 8786  
E-mail: servlab@servlab.co.kr

## Latvia

**IN VITRO EESTI OÜ**  
Tel: +372 630 65 20  
Fax: +372 630 65 22  
E-mail: info@invitro.ee

## Lithuania

**IN VITRO EESTI OÜ**  
Tel: +372 630 65 20  
Fax: +372 630 65 22  
E-mail: info@invitro.ee

## Luxembourg

**ENZO LIFE SCIENCES BVBA**  
Tel: +32 (0) 3 466 04 20  
Fax: +32 (0) 3 466 04 29  
E-mail: info-be@enzolifesciences.com

## Malaysia

**INTERSCIENCE SDN BHD**  
Tel: (0)3 5740 9888  
Fax: (0)3 5740 9866  
E-mail: info@its-interscience.com

## Mexico

**CONSULTORIA DE LABORATORIOS S.A.**  
Tel: +52 (0) 55 4622 2691  
Fax: +52 (0) 55 4622 26910  
E-mail: info@consulab-bqso.com

**UNIPARTS S.A. DE C.V.**  
Tel: (0)55 5281 4712  
Fax: (0)55 5281 4728  
E-mail: uniparts@uniparts.com.mx

## Netherlands

**ENZO LIFE SCIENCES BVBA**  
Tel: +31(0) 76 542 51 84  
Fax: +31(0) 76 542 52 61  
E-mail: info-nl@enzolifesciences.com

## New Zealand

**SAPPHIRE BIOSCIENCE Pty. Ltd.**  
Tel: +61 (0) 2 9698 2022  
Fax: +61 (0) 2 9698 1022  
E-mail: sales@sapphirebioscience.com

**UNITED BIOWESEARCH PRODUCTS**  
Tel: +61 (0) 2 9651 3736  
Fax: +61 (0) 2 9651 4247  
E-mail: kirrily@unitedbiowearch.com.a

## Norway

**AH DIAGNOSTICS AS**  
Tel: (0)23 23 32 60  
Fax: (0)23 23 32 70  
E-mail: ahdiag@ahdiag.no

## Pakistan

**THE WORLDWIDE SCIENTIFIC**  
Tel: (0)42 755 2355  
Fax: (0)42 755 3255  
E-mail: wws@brain.net.pk

## Poland

**BIOMIBO**  
Tel: (0)22 872 07 97  
Fax: (0)22 872 07 97  
E-mail: biomibo@biomibo.com.pl

## Portugal

**BAPTISTA MARQUES, LDA**  
Tel: +351 (21) 722 06 60  
Fax: +351 (21) 722 06 61  
E-mail: geral@baptistamarques.pt

## Romania

**MEDIST SA**  
Tel: (0)21 411 5003  
Fax: (0)21 410 5446  
E-mail: office@medist.ro

## Russia

**CHIMMED Inc.**  
Tel: +7 095 728 4192  
Fax: +7 095 742 8341  
E-mail: bio@chimmed.ru

## Singapore

**ITS SCIENCE AND MEDICAL PTE. LTD.**  
Tel: +62 32 624 0160  
Fax: (0)6273 0810  
E-mail: info@its-science.com

## Slovakia

**GENETICA s.r.o.**  
Tel: +42 (0) 2 7270 1055  
Fax: +42 (0) 2 7270 1739  
E-mail: genetika@genetica.cz

## Slovenia

**A-Ž LAB D.O.O.**  
Tel: +386 (0)1 433 63 22 / +386 (0)1 230 18 84  
Fax: +386 (0)1 230 19 85  
E-mail: az.consulting@siol.net

## South Africa

**BIOCOM BIOTECH**  
Tel: +27 12 654 4614  
Fax: +27 76 374 2093  
E-mail: info@biocombiotech.co.za

## Spain

**GRUPO TAPER SA**  
Tel: +34 916 596 520  
Fax: +34 916 610 084  
E-mail: biointestigacion@grupotaper.com

## Sweden

**Immunkemi F&D AB**  
Tel: (0)8 583 615 00  
Fax: (0)8 583 615 01  
E-mail: sales@immunkemi.se

## Switzerland

**ENZO LIFE SCIENCES AG**  
Tel: +41 (0) 61 926 8989  
Fax: +41 (0) 61 926 8979  
E-mail: info-ch@enzolifesciences.com

## Syria

**NEW-MED TECHNOLOGY**  
Tel: (0)11 88271717  
Fax: (0)11 88271710  
E-mail: new-med@mail.sy

## Taiwan

**HONG JING Co., Ltd.**  
Tel: (0)2 3233 8585  
Fax: (0)2 3233 8686  
E-mail: hongjing@ms10.hinet.net

## Thailand

**THEERA TRADING CO., Ltd.**  
Tel: (0)2 412 5672 / (0)2 418 1068  
Fax: (0)2 412 3244  
E-mail: vtheera@ksc.th.com

**ITS THAILAND Co., Ltd.**  
Tel: (0)2 308 0611  
Fax: (0)2 308 0612  
E-mail: info@its-thailand.com

## Turkey

**TOKRA MEDICAL Ltd.**  
Tel: (0)312 395 60 09  
Fax: (0)312 395 39 61  
E-mail: tokra@tokra.com.tr

## Ukraine

**CHIMMED Inc.**  
Tel: +7 095 728 4192  
Fax: +7 095 742 8341  
E-mail: bio@chimmed.ru

## United Kingdom

**ENZO LIFE SCIENCES (UK) Ltd.**  
Tel: 0845 601 1488 (UK customers)  
Tel: +44 (0) 1392 825900 (from overseas)  
Fax: +44 (0) 1392 825910  
E-mail: info-uk@enzolifesciences.com

## Uruguay

**LAB SCIENTIFIC, INC. (USA)**  
Tel: (305) 716-9922  
Fax: (305) 716-9923  
E-mail: rshlesinger@labscient.com

## USA

**ENZO LIFE SCIENCES INTERNATIONAL, INC.**  
Tel: (610) 941-0430  
Toll Free: 1-800-942-0430  
Fax: (610) 941-9252  
E-mail: info-usa@enzolifesciences.com

## Venezuela

**LAB SCIENTIFIC, INC. (USA)**  
Tel: (305) 716-9922  
Fax: (305) 716-9923  
E-mail: rshlesinger@labscient.com

## Vietnam

**ITS VIETNAM**  
Tel: (0)8 9255 232  
Fax: (0)8 9255 233  
E-mail: gmrs@its-vn.com

**Switzerland & Rest of Europe**

ENZO LIFE SCIENCES AG  
Industriestrasse 17, Postfach  
CH-4415 Lausen / Switzerland  
Tel. + 41/0 61 926 89 89  
Fax + 41/0 61 926 89 79  
info-ch@enzolifesciences.com

**North/South America**

ENZO LIFE SCIENCES INTERNATIONAL, INC.  
5120 Butler Pike  
Plymouth Meeting, PA 19462-1202 / USA  
Tel. 1-800-942-0430/(610) 941-0430  
Fax (610) 941-9252  
info-usa@enzolifesciences.com

**Benelux**

ENZO LIFE SCIENCES BVBA  
Melkerijweg 3  
BE-2240 Zandhoven / Belgium  
Tel. +32/0 3 466 04 20  
Fax +32/0 3 466 04 29  
info-be@enzolifesciences.com

**France**

ENZO LIFE SCIENCES FRANCE  
c/o Covalab s.a.s  
13, avenue Albert Einstein,  
69100 Villeurbanne / France  
Tel. +33/0 472 440 655  
Fax +33/0 437 484 239  
info-fr@enzolifesciences.com

**Germany**

ENZO LIFE SCIENCES GmbH  
Marie-Curie-Strasse 8  
DE-79539 Lörrach / Germany  
Tel. +49/0 7621 5500 526  
Fax +49/0 7621 5500 527  
info-de@enzolifesciences.com

**UK & Ireland**

ENZO LIFE SCIENCES (UK) LTD.  
Palatine House  
Matford Court  
Exeter EX2 8NL / UK  
Tel. 0845 601 1488 (UK customers)  
Tel. +44/0 1392 825900 (overseas)  
Fax +44/0 1392 825910  
info-uk@enzolifesciences.com

**For local distributors see inside**