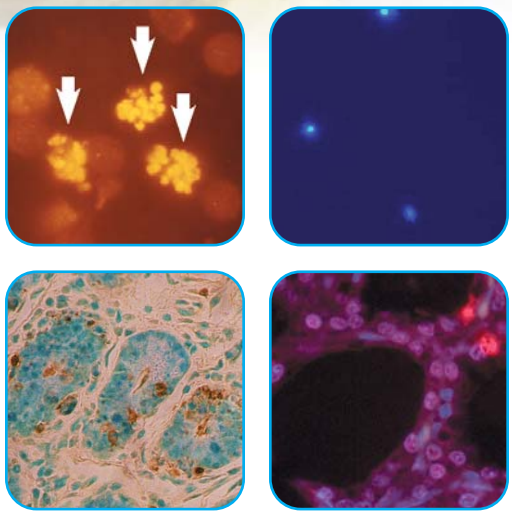
MILLIPORE

# Apoptosis

## Antibodies, Reagents and Kits



upstate | CHEMICON

now part of Millipore

## Introduction

Apoptosis is a critical process for homeostasis ... disruption of an appropriate apoptotic response is implicated in the development of many disease states.

# Upstate®, Chemicon® and Linco® are now part of Millipore

The goal of this combined company is to provide more innovative tools, services and application expertise that will improve your productivity. Our first priority is to support your work as a valued partner. Together we now offer:

- **A broader range of products and services** for markets including drug discovery, protein identification, antibody purification, molecular biology, stem cell research, water purification and general filtration.
- **An increased number of applications and protocols** that facilitate your development process.
- **Extended global expertise, leadership and presence** to serve you more effectively.
- **Larger support and research development teams** to deliver innovative products that cost-effectively impact your business.

# Apoptosis

## Antibodies, Reagents and Kits



All prices listed in US Dollars.

# Apoptosis

## Programmed Cell Death

### A Brief Review

Apoptosis, or programmed cell death, is a process for the orderly disposal of unwanted cells without the development of an inflammatory response, which is often associated with necrotic cell death. Table 1 highlights the differences between apoptosis and necrosis.

Apoptosis is required for many normal physiological functions. For example, interdigital apoptosis is a critical developmental process that contributes to the formation of fingers and toes; disruptions in this process lead to severely debilitating congenital birth defects. In addition, normal resolution of inflammation requires that inflammatory cells undergo apoptosis in order to prevent chronic inflammation.

Apoptosis is also linked to cancer. Normal cells exhibit adhesion-dependent growth; they must be attached (to other cells or an extracellular matrix) for survival. Cell adhesion transmits survival signals, and loss of these signals triggers apoptosis. Cells must not survive should they migrate to a new tissue, where they may exhibit unregulated growth. In fact, most cancer cells have lost adhesion-dependence. Growth in soft agar and "piling", characteristics of cells which have lost adhesion-dependence, are also behaviors observed in cells isolated from aggressive and metastatic cancer. Vast effort has been expended to identify steps in the apoptotic cascade that may serve as targets for cancer therapy.

### "Extrinsic" versus "Intrinsic" Apoptosis Induction

At least two pathways lead to apoptosis, the "extrinsic" and "intrinsic" pathways. The extrinsic pathway is initiated by extracellular determinants through "death receptors". Binding of Fas ligand to its receptor results in receptor trimerization and the formation of an intracellular complex composed of Fas "death domains", the protein FADD and pro-Caspase 8 (an initiator Caspase; others include Caspases 9, 10 and 12). Pro-Caspase 8 undergoes proteolytic processing to form active Caspase 8. Activated Caspase 8 activates pro-Caspase 3; active Caspase 3 is a principle effector caspase of apoptosis. Caspase 8 also activates the protein Bid, which activates Bak and Bax. Similar processes are initiated from the TNF receptor, another death receptor family member, which recruits TRADD, and pro-Caspase 8 and so on.

The intrinsic pathway begins when an injury occurs within the cell as a result of drug treatment,

**Table 1: Apoptosis vs. Necrosis**

| | Apoptosis | Necrosis | |
|---|---|---|---|
| Incidence | Scattered | Localized | |
| Cell Volume | Shrunken | Swollen | Morphological Differences |
| Cell Surface | Sealed | Leaky | |
| Chromatin | Condensed | Clumped | |
| Response | Phagocytosis | Inflammation | |
| Onset | Regulated | Accidental | |
| Enzyme Cascade | Complete | Truncated | Biochemical Differences |
| Biosynthesis | Viable | Non-viable | |
| DNA Fragmentation | Non-random (Laddered) | Random (Smeared) | |

radiation (i.e., radiation-induced DNA damage) or detoxification-induced redox damage. Mitochondria are pivotal in orchestrating events that keep a cell alive or commit it to death. The key event seems to be mitochondrial membrane permeabilization and release of Cytochrome C (Cyt-C). Cytoplasmic Cyt-C binds to and activates the protein Apaf-1, which activates pro-Caspase 9. Active Caspase 9 then activates Caspase 3 (see Figure 2: Caspases on page 6).

This process is complicated as mitochondrial membrane permeability (and Cyt-c release) is induced by the proteins Bak and Bax, which are activated by BID (Figure 1). The pro-survival protein Bcl-2 prevents apoptosis, probably by binding to Cyt-C or Apaf-1,

*Figure 1. Apoptosis versus survival is a complex process with many checks and balances that must function in a concerted manner to allow survival or induce death. A wide variety of cellular proteins, including cell surface receptors, adapters, proteases and mitochondrial components, are required to function along carefully delineated and regulated signaling pathways to permit cell survival or to promote death by apoptosis.*

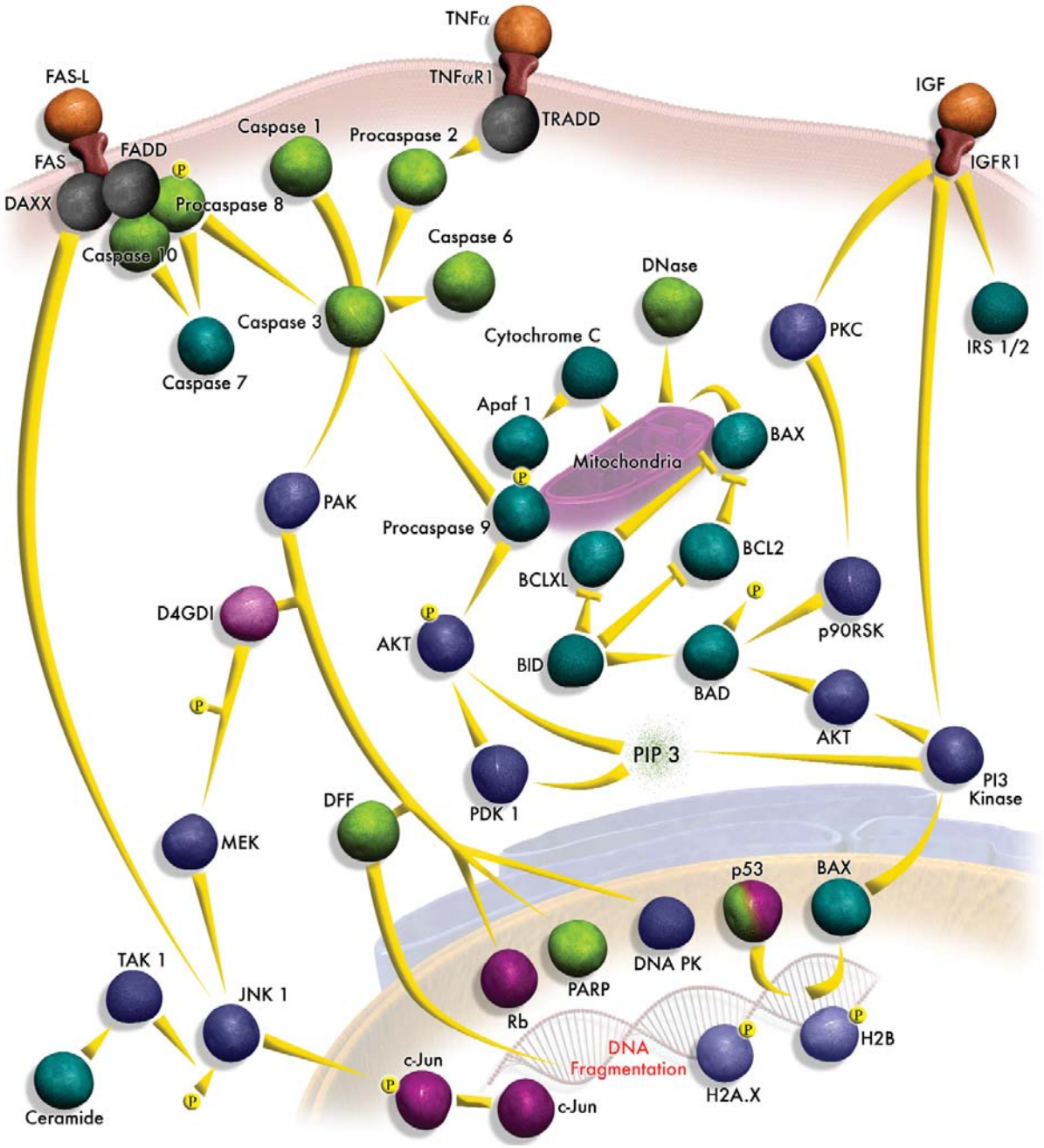


*Figure 2: Caspases. Pro-apoptotic signals reaching the mitochondria promote release of Cytochrome C (Cyt-C), which binds the pro-apoptotic protein Apaf-1. The pro-apoptotic Apaf-1: Cyt-C complex activates cleavage of Procaspase 9 to produce the active initiator caspase, Caspase 9. Activated Caspase 9 then causes cleavage of Procaspase 3 to produce the active effector caspase, Caspase 3.*

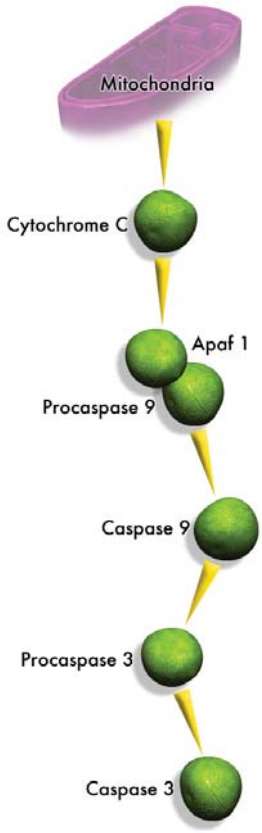



*Figure 3: Bad Regulation. Survival signals result in activation of Akt, which phosphorylates the Bcl-family protein Bad, and promotes survival. Unphosphorylated Bad dimerizes with Bcl-2 and Bcl-XL, preventing them from performing their pro-survival function, and thus promoting cell death. Phosphorylated Bad is unable to associate with Bcl-2 and Bcl-XL, allowing them to perform their pro-survival function.*


or through binding to Bak and Bax, preventing release of Cyt-C. The pro-apoptotic protein Bad binds to Bcl-2 and Bcl-XL, preventing their pro-survival function. Survival signals, however, activate the kinase Akt, which phosphorylates Bad and prevents binding to Bcl-2, promoting survival (see Figure 3: Bad Regulation). Inhibitor of Apoptosis Proteins (IAPs) normally bind and prevent activation of Caspase 3. Mitochondrial proteins released by Bak and Bax, such as Smac/DIABLO and Omi/HtrA2, counteract the effect of IAPs and promote death. The abundance, location and phosphorylation state of all of these proteins are essential in deciding between life and death; disruptions in any of them produce aberrant apoptosis. These checks and balances provide assurance that apoptosis occurs only when necessary.

Both pathways result in activation of effector Caspases, such as Caspase 3. Effector Caspases (Caspases 3, 6 and 7) are the executioners of apoptosis, as they are responsible for the degradation of other cellular proteins (i.e., cytoskeletal proteins) prior to packaging and disposal. Subsequent processes result in many events, including phosphorylation of histone H2A.X (Ser149) and H2B (Ser14), cleavage of PARP, chromatin condensation, inter-nucleosomal degradation of DNA and packaging of the cell into "apoptotic bodies" that are taken up by phagocytes.

## Loss of Membrane Asymmetry

A very early event in apoptosis is loss of membrane asymmetry (see Figure 5 on page 10). This occurs as the membrane phospholipid phosphatidylserine (PS), normally present on the inner leaflet of cell membranes, redistributes to both the inner and outer leaflets. PS translocation is a key event, as cells lacking PS are not phagocytized. It seems that PS on the outside of a cell is the trigger for recognition by a PS receptor on phagocytic cells, which recognize and remove dying cells. PS receptor deficient mice accumulate dead cells, resulting in embryonic lethality.

## Ubiquitin-Mediated Regulation of Apoptosis

Previous work has shown the extensive role of phosphorylation in regulating Apoptosis. What is becoming more evident is apoptosis regulation mediated by ubiquitin and ubiquitin-like proteins. Like cell division and DNA Damage repair, apoptosis requires extremely tight regulation to be initiated in the proper context. Mostly, addition of ubiquitin to target proteins results in rapid and irreversible protein degradation

via the proteosome. Protein degradation is an efficient and quick mechanism to eliminate proteins that have crucial activities. For example, pro-survival Bcl-2 family members are specifically degraded in response to TNF-α mediated apoptosis, thereby eliminating its "survival" ability. This is a key event in TNFα mediated apoptosis. There are many more examples of ubiquitin mediated degradation of key apoptotic proteins, this is just one. However, degradation is not the only outcome. Ubiqutin and other ubiquitin-like proteins can regulate other cellular events like trafficking, protein-protein, interactions and activation/deactivation. Active research in these areas will soon provide details on the regulatory ability of ubiquitin on the apoptosis pathway.

There are many more proteins and pathways involved in apoptosis than could be mentioned here. Indeed, there have been nearly 80,000 publications on the subject, including over 13,000 reviews. Apoptosis is a critical process during development and is fundamental to homeostasis in nearly all multicellular organisms. Disruption of an appropriate apoptotic response is implicated in the development of many disease states, including cancer (lack of apoptosis) or one of several degenerative diseases (enhanced apoptosis).

References


1. Cheng, E.H., *et al.* BCL-2, BCL-X(L) sequester BH3 domain-only molecules preventing BAX- and BAK-mediated mitochondrial apoptosis. *Mol. Cell.*, **8**: 705-711, 2001.
2. Cory, S., and Adams, J.M. The Bcl2 family: regulators of the cellular life-or-death switch. *Nat. Rev. Cancer*, **2**: 647-656, 2002.
3. Huppertz, B., *et al.* The apoptosis cascade–morphological and immunohistochemical methods for its visualization. *Anat. Embryol. (Berl.)*, **200**: 1-18, 1999.
4. Peter, M.E., and Krammer, P.H. The CD95(APO-1/Fas) DISC and beyond. *Cell Death Differ.*, **10**: 26-35, 2003.
5. Reed, J.C. Apoptosis-regulating proteins as targets for drug discovery. *Trends Mol. Med.*, **7**: 314-319, 2001.
6. Schulze-Bergkamen, H., and Krammer, P.H. Apoptosis in cancer-implications for therapy. *Semin. Oncol.*, **31**: 90-119, 2004.
7. Shum L., *et al.* Morphogenesis and dysmorphogenesis of the appendicular skeleton. *Birth Defects Res. Part C Embryo Today*, **69**: 102-122, 2003.
8. Vaux, D.L., and Strasser, A. The molecular biology of apoptosis. *Proc. Natl. Acad. Sci. USA*, **93**: 2239-2244, 1996.
9. Wei, M.C., *et al.* Proapoptotic BAX and BAK: a requisite gateway to mitochondrial dysfunction and death. *Science*, **292**: 727-730, 2001.

# Akt/PKB

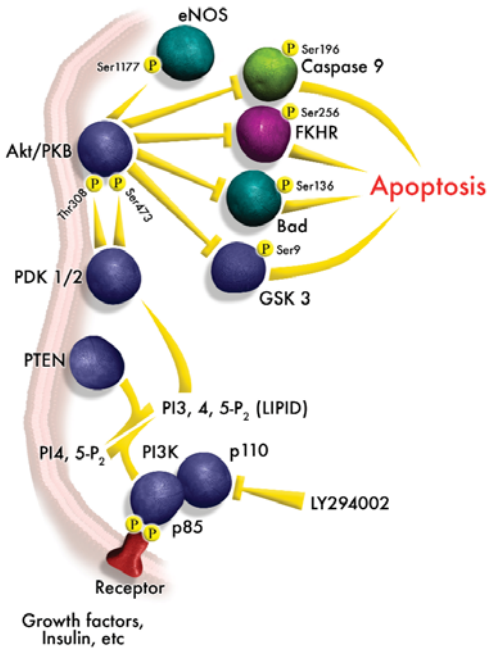
## A Key Molecule in Apoptosis Regulation

### Background

The Ser/Thr kinase Akt is a major known effecter of the PI 3-Kinase pathway and is involved in multiple signaling pathways that relate to many biological processes including cell survival, cell cycle control, cell growth and cell metabolism. The activity of Akt is regulated by its phosphorylation status, primarily on two residues, Thr308 and Ser473. A better understanding of its activation/deactivation was only recently further elucidated by the discovery of the TORC2 kinase complex and PHLPP1 & 2 phosphatases. The regulation of Akt activity and downstream targets greatly affect the cell's ability to enter into apoptosis. With Akt having so many signaling partners and its involvement in multiple signaling pathways and cellular mechanisms, it is no wonder why Akt is so well studied and a highly sought after drug target.

The activation and regulation of Akt is dependent on a dual regulatory mechanism that requires both its translocation to the plasma membrane and dual phosphorylation on Thr308 and Ser473 by PDK1 and the TORC2 complex, respectively (Figure 5). This is accomplished by the generation and build-up of PIP3 by PI3K in conjunction with reduced PTEN function, which results in the activation of PDK1 (3-phospho-inositide-dependent protein kinase-1) and the recruitment of Akt to the plasma membrane by direct interaction with its PH domain. PDK1 then in turn phosphorylates Akt on Thr 308 in its activation loop. This phosphorylation is necessary and sufficient for Akt activation; however maximal activation requires the additional phosphorylation at Ser473. Another kinase complex, recently determined as TORC2 that is composed of the mTOR/Rictor heteroduplex (previously referred to as the unidentified kinase PDK2) phosphorylates Akt on Ser473 in the hydrophobic motif. This latter phosphorylation/activation is not fully understood. Following its activation, Akt is released from the plasma membrane into the cytosol and nucleus where it interacts and phosphorylates multiple binding partners including FKHR, BAD and GSK. These two phosphorylation sites are regulated by two different phosphatases. The dephosphorylation event results in the termination of Akt activity which is much less understood than its activation. This process was less understood until the recent discovery of two new phosphatases, PHLPP1 and PHLPP2 (PH domain leucine-rich repeat protein phosphatase), which dephosphorylates Akt in the cytoplasm and nucleus, respectively (specifically on the hydrophobic phosphorylation site of Ser473, but not the Thr308 site). Interestingly, dephosphorylation on this site has been shown to trigger apoptosis and the suppression of tumor growth. Another phosphatase, PP2A, that is much precarious, is now believed to dephosphorylate Akt on the PDK1 phosphorylation site of Thr308. Together, they help regulate the activity of Akt.

*Figure 4. The direct interaction of activated PDK1 with Akt results in the recruitment of Akt to the plasma membrane and the subsequent phosphorylation and activation of Akt. Activated AKT is then released from the plasma membrane into the cytosol and nucleus where it interacts with and phosphorylates multiple binding partners including Caspase 9, Bad, and GSK3 resulting in the inhibition of apoptosis and the promotion of cell survival.*



Akt functions in many anti-apoptotic pathways through its binding of many apoptotic mediators that become either activated or de-activated through their Akt phosphorylation. The Akt cell survival mechanism via cell cycle, growth translation and apoptosis is likely to involve many targets that it phosphorylates. These downstream mediators of apoptosis can be divided into two separate groups: ones that Akt activates via phosphorylation, such as Caspase 9, IKK, MDM2, NFκB and mTOR and ones that it inhibits via phosphorylation, such as GSK3β, FKHR and BAD. Akt activates many targets that inhibit various apoptosis pathways. The phosphorylation of Caspase-9 on Ser196 by Akt results in the inhibition of its catalytic activity. In the NFκB pathway, which promotes survival in response to pro-apoptotic stimuli, Akt phosphorylates IKK (IκB Kinase) that results in the phosphorylation and subsequent degradation of the NFκB inhibitor IκB. This frees the NFκB p50/p65 complex to translocate from the cytoplasm to the nucleus where it activates its target genes. Akt also helps mediate the pro-apoptotic tumor suppressor/transcription factor p53 by phosphorylating its negative regulating binding protein MDM2. Akt phosphorylation of MDM2 allows it to more efficiently translocate to the nucleus where it binds to p53 and target it for degradation by the proteosome through E3 ubiquitin ligase activity. For others, Akt phosphorylation results in its inactivation. For the pro-apoptotic member of the BCL2 family, BAD, phosphorylation on Ser136 prevents BAD from interacting with BCL-XL, thus enabling the anti-apoptotic function of BCL-XL. Akt also phosphorylates the FOXO family of transcription factors. For FKHR, it is on sites Thr24/Ser256/Ser319. This phosphorylation results in it bidding to 14-3-3 and ultimately its inactivation of cytoplasm/nuclear shuttling and prevents the activation of the FKHR target genes that include many pro-apoptotic proteins, such as BIM and FAS ligand. Finally, as cell cycle control is very important is growth and apoptosis, the levels of Cyclin D1 are very important as they are important in the G1/S phase transition. Akt aids in the role of preventing the degradation of CyclinD1 by regulating the activity of GSK3β (Glycogen Synthase Kinase-3β) by its phosphorylation, thus de-activating it. GSK3β phosphorylates CyclinD1 and marks it for degradation. If its activity is blocked, then CyclinD1 will not be marked for degradation and will accumulate in the cell. In addition to CyclinD1, GSK also phosphorylates many other downstream targets that affect apoptosis and cell cycle regulation, including c-Myc and Cyclin E and the transcription factors c-Jun, β-catenin, GLI, Notch, Snail and SREBP1. Millipore offers a complete Akt/PKB solution with Upstate antibodies, kinases, phosphatases, substrates and siRNA for targets upstream and downstream of Akt. This includes mouse and rabbit monoclonal and polyclonal antibodies directed against total and phospho-specific variants Akt, as well as Alexa Fluor® conjugates. High quality active and inactive Upstate kinases of both upstream activators and downstream substrates are available. Activation of Akt can be measured directly by immunoprecipitation followed by phosphorylation of a known substrate with radio labeled ATP or with many of our phospho-specific antibodies such as AS160, PRAS40, cardiac PFK2, BAD, FKHR and GSK3. Millipore has what you need for your Akt research.

References


1. Shaw, R.J. and Cantley, L.C. Ras, PI(3)K and mTOR Signalling Controls Tumour Cell Growth. *Nature*, **441**: 424-430, 2006.
2. Fesik, S.W. Promoting Apoptosis as a strategy for Cancer Drug Discovery. *Nature Reviews Cancer*, **5**: 876-885, 2005.
3. Gao, T, Furnari, F, and Newton, A.C. PHLPP: A Phosphatase that Directly Dephosphorylates Akt, Promotes Apoptosis, and Suppresses Tumor Growth. *Mol. Cell.*, **18**: 13-24, 2005.
4. Vivanco, I and Sawyer, C.L. The Phosphatidylinositol 3-Kinase-AKT Pathway in Human Cancer. *Nature Reviews Cancer*, **2**: 489-501, 2002.

# Anti-Phosphatidlyserine

## Clone 1H6, Alexa Fluor 488 conjugate

*Anti-Phosphatidylserine, now conjugated with Alexa Fluor 488, is perfect for your flow cytometry and immunofluorescence applications.*

Antibody-based detection of early apoptotic events is now possible for less cost than Annexin V assays. Upstate's Anti-Phosphatidylserine, clone 1H6, Alexa Fluor 488 from Millipore, a monoclonal antibody that detects the initial cellular changes of apoptosis, is sensitive, specific and useful for flow cytometry studies for only $0.68 per assay. It can also be used for immunocytochemistry.

Apoptosis, or programmed cell death, is a physiological mechanism for the neat and tidy elimination of unnecessary or unwanted cells. One well-documented event that occurs very early in apoptosis is the loss of membrane phospholipid – asymmetry [the "phosphatidylserine (PS) flip" – see Figure 5]. Following the initiation of apoptosis, PS flips from the cytoplasmic to the extracellular side of the still-intact cell membrane. The PS flip occurs well before any other apoptosis events, such as caspase activation, PARP cleavage or DNA fragmentation.

Cell-surface PS is thought by some to be a marker for recognition and phagocytosis of apoptotic cells. PS is recognized by a PS Receptor (PSR) on phagocytes and PSR gene knockout has been shown to be an embryonic lethal mutation. This seems to be critical in prevention of an inflammatory response to cell death. Other reports have suggested, on the other hand, that the PSR is not as critical in clearance of apoptotic cells.

Anti-Phosphatidylserine, clone 1H6, Alexa Fluor 488 delivers long-term product consistency, high specificity and is more affordably priced than Annexin V recombinant protein-based assays. For more information on Anti-Phosphatidylserine, clone 1H6,Alexa Fluor 488 and our other products for the study of apoptosis, visit our website at www.millipore.com/apoptosis.


References

1. Botto, M. Arthritis. *Res. Ther.*, **6**: 147-150, 2004.
2. Hong, J.R., *et al.*, *Development*, **131**: 5417-5427, 2004.
3. Kunisaki, Y., *et al.*, *Blood*, **103**: 3362-3364, 2004.
4. Hoffmann, P.R., *et al.*, *J. Immunol.*, **174**: 1393-1404, 2005.
5. Mitchell, J.E., *et al.*, *J. Biol. Chem.*, **281**: 5718-5725, 2006.


*Figure 5: Phosphatidylserine "Flip". PS is a membrane phospholipid that is normally localized to the inner surface of cell membranes. During apoptosis, PS redistributes from the inner membrane leaflet to both the inner and outer membrane leaflets. "Loss of membrane asymmetry" is a key marker for apoptosis.*

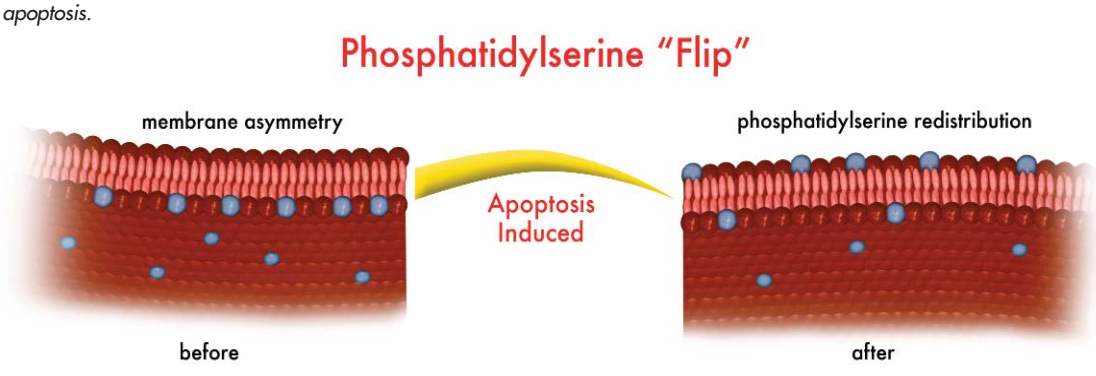
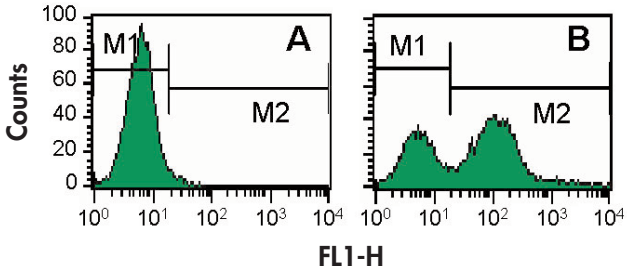
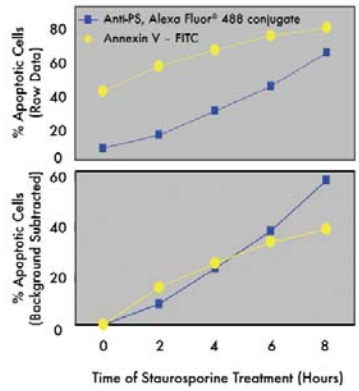


*Figure 6: Suspension Array Detection. Jurkat cells were cultured in the absence (A) or presence (B) of staurosporine (left; 2 µg/ml for up to 8 hours). The relative proportions of apoptotic cells were analyzed by flow cytometry using Anti-Phosphatidylserine, clone 1H6, Alexa Fluor 488 conjugate (0.2 µg) or an Annexin V FITC conjugate (data not shown). The time course for induction of apoptosis is shown at right.*




## Products for Phosphatidylserine Detection

| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| Anti-Phosphatidylserine, clone 1H6, Alexa Fluor 488 conjugate | 100 µg | 16-256 | $339 |
| Unconjugated Anti-Phosphatidylserine Antibody | 200 µg | 05-719 | $339 |
| **Related Products** | | | |
| Propidium Iodide Solution | 1 mL | S7109 | $60 |
| Propidium Iodide/Antifade Solution | 1 mL | S7112 | $60 |

# Other Apoptosis Detection Products

## TUNEL Based Apoptosis Detection Kits

| | | | |
|---|---|---|---|
| ApopTag Fluorescein *In Situ* Apoptosis Detection Kit | 40 assays | S7110 | $405 |
| ApopTag Plus Fluorescein *In Situ* Apoptosis Detection Kit | 40 assays | S7111 | $415 |
| ApopTag Red *In Situ* Apoptosis Detection Kit | 40 assays | S7165 | $390 |

## Active Caspase Detection Kits

| | | | |
|---|---|---|---|
| CaspScreen Flow Cytometric Apoptosis Detection Kit | 25 assays | APT105 | $395 |
| CaspaTag Pan-Caspase *In Situ* Assay Kit | 100 assays | APT400 | $435 |
| CaspaTag Caspase-3,7 *In Situ* Assay Kit | 100 assays | APT403 | $435 |

## Antibodies to Apoptosis Specific Cleavage Products

| | | | |
|---|---|---|---|
| Anti-Fractin (32 kDa Fragment of β-Actin) | 100 µL | AB3150 | $265 |
| Anti-PARP (Inactive and Cleaved) | 100 µL | AB16661 | $330 |

# Apoptosis
## Detection Kits

### Millipore's Offering

Millipore offers Apoptosis Detection Kits for researchers to determine if apoptosis is occurring in cells or tissue of interest. The broad variety of choices allows the researcher to choose the kit that best fits their needs. The kits are shown below based on their detection options.

**Table 2:**

Recommended Sample Types for Kits

| Sample Type | ApopTag | CaspaTag | MitoLight | Glutathione | DNA Ladder | CaspSCREEN | Anti-PS* |
|---|---|---|---|---|---|---|---|
| Adherent Cells | ● | ● | ● | ● | ● | | ● |
| Suspended Cells | ● | ● | ● | ● | ● | ● | ● |
| Tissues | ● | | | | ● | | |

**Anti-Phosphatidlyserine (Anti-PS)*

Apoptosis Detection Kits by Hallmark Apoptotic Event

| Detection Method | Extracellular Phosphatidylserine Exposure | Caspase Activity | GSH Level Changes | Mitochondrial Permeabilization | DNA Fragmentation |
|---|---|---|---|---|---|
| Flow Cytometry | **Anti-PS** Page 11 **Cat. Nos.** 16-256, 05-719 | **CaspaTag** Page 13 **Cat. Nos.** APT400, APT403, APT420, APT423, APT408, APT428, APT409, APT429<br>**CaspSCREEN** Page 17 **Cat. No.** APT105 | | **MitoLight** Page 15 **Cat. Nos.** APT142, APT242 | **ApopTag** Page 17 **Cat. Nos.** S7110, S7111, S7165, S7160<br>**Apo-Direct** Page 16 **Cat. No.** APT110 |
| Fluorescence Microscopy | **Anti-PS** Page 11 **Cat. Nos.** 16-256, 05-719 | **CaspaTag** Page 13 **Cat. Nos.** APT400, APT403, APT500, APT503, APT420, APT423, APT408, APT428, APT409, APT429, APT520, APT523 | **Glutathione Detection Kit** Page 14 **Cat. No.** APT250 | **MitoLight** Page 15 **Cat. Nos.** APT142, APT242 | **ApopTag** Page 17 **Cat. Nos.** S7110, S7111, S7165 |
| Fluorescence Reader | | **CaspaTag** Page 13 **Cat. Nos.** APT400, APT403, APT500, APT503, APT420, APT423, APT408, APT428, APT409, APT429, APT520, APT523 | | **MitoLight** Page 15 **Cat. Nos.** APT142, APT242 | **ApopTag** Pages 16 & 17 **Cat. Nos.** S7100, S7101, S7200 |
| Light Microscopy | **Anti-PS** Page 11 **Cat. Nos.** 16-256, 05-719 | | | | |
| Agarose Gel | | | | | **DNA Ladder** Page 15 **Cat. No.** APT151 |

## CaspaTag *In Situ* Apoptosis Detection Kits

Chemicon CaspaTag *In Situ* Apoptosis Detection Kits from Millipore detect caspases in living cells undergoing apoptosis. Fluorescently labeled inhibitors of caspase activity irreversibly bind to active caspases, allowing apoptotic cells to be identified by their fluorescence using flow cytometry, fluorescence microscopy or fluorescence reader.

CaspaTag Kits utilize carboxyfluorescein (FAM) or sulforhodamine (SR) labeled fluoromethyl ketone (FMK) inhibitor probes. These probes are derivatives of benzyloxycarbonyl-peptide (caspase recognition sequence)-FMK caspase inhibitors. They enter the cell and irreversibly bind to caspase 3, 7 (DEVD), caspase 8 (LETD), caspase 9 (LEHD) or all caspases (VAD).

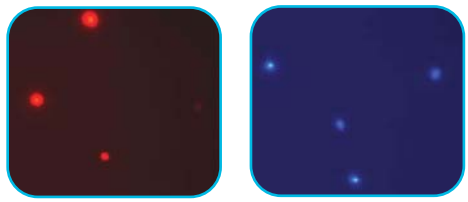
### CaspaTag Advantages

**Fast:** Assay completed in less than 90 minutes

**Simple:** One-step assay in live cells

**Effective:** Irreversibly binds to active caspases with high affinity

*Figure 7: Suspension Array Detection.* ***Jurkat cells were treated with camptothecin to induce apoptosis. Cells were then labeled with SR-VAD-FMK and Hoescht stain and visualized by fluorescence microscopy. Cells with caspase activity are shown in red (right) while nuclear staining of all cells is shown in blue (left).***



| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| CaspaTag Pan-Caspase *In Situ* Assay Kit, Fluorescein | 25 assays | APT420 | $155 |
| CaspaTag Pan-Caspase *In Situ* Assay Kit, Fluorescein | 100 assays | APT400 | $435 |
| CaspaTag Pan-Caspase *In Situ* Assay Kit , Sulforhodamine | 25 assays | APT520 | $185 |
| CaspaTag Pan-Caspase *In Situ* Assay Kit, Sulforhodamine | 100 assays | APT500 | $470 |
| CaspaTag Caspase-3,7 *In Situ* Assay Kit, Fluorescein | 25 assays | APT423 | $155 |
| CaspaTag Caspase-3,7 *In Situ* Assay Kit, Fluorescein | 100 assays | APT403 | $435 |
| CaspaTag Caspase-3,7 *In Situ* Assay Kit, Sulforhodamine | 25 assays | APT523 | $185 |
| CaspaTag Caspase-3,7 *In Situ* Assay Kit, Sulforhodamine | 100 assays | APT503 | $490 |
| CaspaTag Caspase-8 *In Situ* Assay Kit, Fluorescein | 25 assays | APT428 | $155 |
| CaspaTag Caspase-8 *In Situ* Assay Kit, Fluorescein | 100 assays | APT408 | $440 |
| CaspaTag Caspase-9 *In Situ* Assay Kit, Fluorescein | 25 assays | APT429 | $155 |
| CaspaTagCaspase-9 *In Situ* Assay Kit, Fluorescein | 100 assays | APT409 | $440 |

## CaspSCREEN Flow Cytometric Apoptosis Detection Kit

The Chemicon CaspSCREEN Flow Cytometric Apoptosis Detection Kit from Millipore provides a simple and convenient means for detecting active caspases by flow cytometry in non-adherent cells. The assay utilizes a molecule that contains rhodamine 110 linked to two aspartate residues (D2R), a reported substrate for the caspase protease family. The intact substrate is non-fluorescent; however, upon cleavage by caspases, the released rhodamine 110 gives rise to fluorescence that can be measured at Ex = 488 nm and Em = 530 nm. The D2R substrate is more cell-permeable than other fluorometric caspase substrates to effectively and easily detect caspase activity, and therefore, apoptosis.

### CaspSCREEN Advantages

**Fast:** Flow cytometry assay to detect all caspase activity

**Simple:** One-step assay in live cells

**Effective:** Cell-permeable caspase substrate for use in live cells

*Figure 8. Detection of Apoptosis by CaspSCREEN Flow Cytometric Analysis Kit*

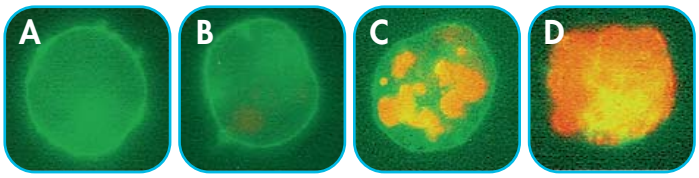

| | | | |
|---|---|---|---|
| CaspSCREEN Flow Cytometric Apoptosis Detection Kit | 25 assays | APT105 | $395 |

## ApopNexin Apoptosis Detection Kits

Chemicon ApopNexin Apoptosis Detection Kits from Millipore detect the appearance of PS in the outer leaflet of the membrane of the cell. The system uses Annexin V conjugated to either FITC or Biotin to allow for convenient quantitative assays. The counterstain Propidium Iodide is included to differentiate the apoptotic and necrotic cells.

ApopNexin FITC binding can be analyzed by flow cytometry or fluorescence microscopy in less than one hour. It may be used in conjunction with other fluorescent cell surface markers. ApopNexin Biotin can be used for chromogenic or fluorescence detection using a streptavidin conjugate of choice. This versatile approach also allows bicolor or tricolor fluorescence experiments for mutliparameter cell surface analysis. Fixation can be performed after Annexin V binding for further analysis of other cellular antigens.

*Figure 9. Human peripheral blood lymphocytes induced with an anti-Fas antibody for 3-4 hours and then assayed with ApopNexin FITC and propidium iodide. Results obtained by fluorescence microscopy show that apoptotic cells have ApopNexin FITC bound to the PS on the outer membrane surface (Panel A). As apoptosis progressed, the plasma membrane becomes permeable, and the propidium iodide is able to enter into the cell and bind to cellular DNA (Panels B and C). Necrotic cells are detected by intense propidium iodide staining of the cytoplasm, due to complete disruption of the plasma membrane (Panel D).*




### ApopNexin Advantages

**Sensitive:** Highly sensitive and specific biochemical results

**Fast:** Quantitative results using flow cytometry

**Effective:** Two labeling options

| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| ApopNexin Biotin Apoptosis Detection Kit | 100 tests | APT700 | $380 |
| ApopNexin FITC Apoptosis Detection Kit | 100 tests | APT750 | $380 |

*Figure 10. Fluorometric analysis of dye bundling in control versus apoptotic cell.*

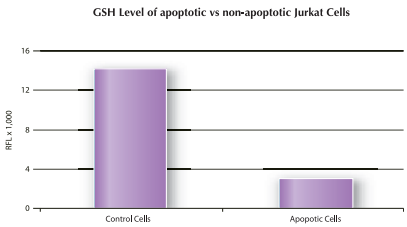
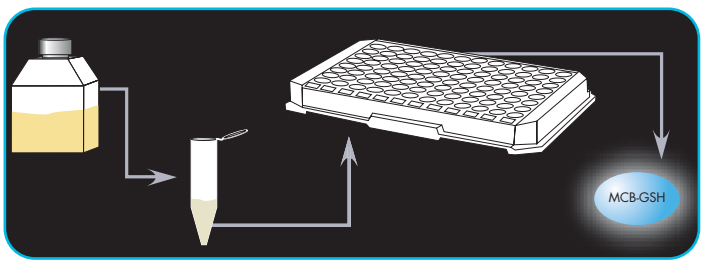



*Figure 11: Glutathione Detection Kit – Protocol.*

- *Wash pellet and discard supernatant*
- *Resuspend pellet in lysis buffer*
- *Centrifuge and collect lysate*
- *Add MCB fluorochrome*
- *Fluorochrome bound to GSH fluoresces blue*




## Glutathione Detection Kit

Reduced glutathione is an antioxidant in human tissues that removes reactive oxygen species from cells. The oxidized form of glutathione is returned to its reduced form by glutathione reductase. In cells undergoing apoptosis, the cytosolic level of reduced glutathione is decreased. Chemicon's Glutathione Detection Kit from Millipore measures the level of reduced glutathione (GSH) in the cytosol using a fluorometric indicator dye which binds preferentially to GSH. The unbound dye shows virtually no fluorescence, while the dye bound to GSH fluoresces blue. The blue fluorescence is detected using a standard fluorometer or fluorescence plate reader.

### Glutathione Advantages

**Fast:** Assay completed in a little over an hour

**Simple:** Fluorescence detection using a standard fluorometer or fluorescence plate reader.

| | | | |
|---|---|---|---|
| Glutathione Detection Kit | 100 assays | APT250 | $325 |

## MitoLight Mitochondrial Permeabilization Detection Kits

The Chemicon MitoLight Mitochondrial Apoptosis Detection Kit from Millipore is a quick and easy method for detecting changes in the mitochondrial membrane potential in live cells. Mitochondrial depolarization is a well-characterized event in apoptosis that can be detected using MitoLight. This lipophilic cationic dye stains living cell mitochondria in a membrane potential-dependent fashion. In healthy cells, the dye accumulates and aggregates in the mitochondria and fluoresces red (l em = 585-590 nm). During apoptosis, the electrochemical gradient across the mitochondrial membrane breaks down (presumably due to the formation of additional pores in the membrane), and the dye remains in the cytosol in its monomeric form and fluoresces green (l em = 527-530 nm).

The MitoLight Mitochondrial Apoptosis Detection Kit will work with adherent cells and cells in suspension. With cells in suspension, the analysis can be performed by fluorescence microscopy or by flow cytometry; with adherent cells, the analysis must be performed using fluorescence microscopy.

*Figure 12. Analysis of Apoptosis by MitoLight.*

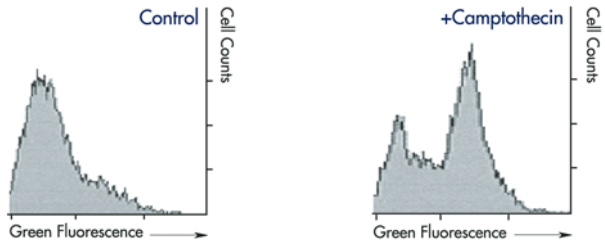
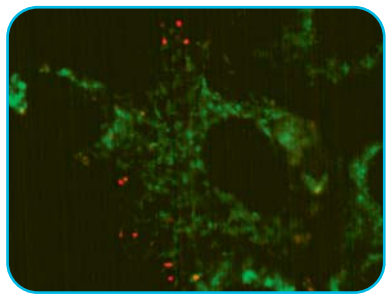



*Figure 13. Fluorescence Microscopy of NIH3T3 cells incubated with MitoLight reagent for 30 minutes at 37 °C.*



### MitoLight Advantages

**Fast:** Assay complete in 20 minutes

**Simple:** Incubate the cells with the MitoLight dye, wash and analyze

**Effective:** Accurate detection of changes in mitochondrial membrane potential

| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| MitoLight Mitochondrial Apoptosis Detection Kit | 25 assays | APT142 | $170 |
| MitoLight Mitochondrial Apoptosis Detection Kit | 100 assays | APT242 | $305 |

## DNA Ladder Detection Kit

The Chemicon DNA Ladder Kit from Millipore provides a fast, simple method for the detection of apoptotic cells. The procedure involves lysis of the cells followed by sequential digestion of RNA and proteins. The genomic DNA is then precipitated, resuspended and separated on an agarose gel. Unlike other kits, our method requires less than 90 minutes to prepare DNA in a single tube without the need for extraction or expensive columns. DNA fragmentation is easily visualized by agarose gel electrophoresis. The assay procedure also increases recovery of small fragmented DNA, resulting in greater sensitivity.

### DNA Ladder Advantages

**Fast:** Requires less than 90 minutes

**Simple:** Single tube, straightforward detection of apoptotic cells by agarose gel

| | | | |
|---|---|---|---|
| DNA Ladder Detection Kit | 50 assays | APT151 | $280 |

## ApopTag Peroxidase ISOL Apoptosis Detection Kit

The Chemicon ApopTag Peroxidase ISOL Apoptosis Detection Kit from Millipore is the newest member of the ApopTag family of Apoptosis Detection Kits. Like the original ApopTag kits, the ApopTag ISOL Kit detects DNA fragmentation by end-labeling the DNA. However, this kit uses a novel "*In Situ* Oligo Ligation (ISOL)" method to label the ends of DNA fragments that takes advantage of the prevalence of blunt-ends and 3' single-base overhangs characteristic only to apoptotic cells. This allows the ApopTag ISOL Kit to clearly differentiate cells undergoing apoptosis from cells undergoing necrosis (see Figure 14).

The ApopTag ISOL Kit procedure (shown in Figure 15) attaches a specific biotinylated, synthetic oligonucleotide to the fragmented DNA *in situ*, provided that the DNA has a blunt end or a single base overhang on its 3' end. Either Oligo A (3' overhang) or Oligo B (blunt end) will bind to an exact complementary, double-stranded DNA end in a reaction catalyzed by T4 DNA Ligase. Then, a streptavidin-peroxidase conjugate is added that binds tightly to the biotin on the oligo. Lastly, the addition of DAB (diaminobenzidine), a chromogenic peroxidase substrate, causes a brown precipitate that can be clearly visualized using brightfield microscopy.

### ApopTag Peroxidase ISOL Advantages

**Innovative:** Novel labeling method that clearly differentiates apoptotic from necrotic cells

**Sensitive:** Minimizes background through high specificity of *in situ* labeling

**Accurate:** Reduces the incidence of false positives

**Flexible:** Detects apoptotic cells in paraffin-embedded tissues, fixed adherent cells, frozen tissues and cell suspensions

*Figure 14. Detection of apoptotic cells in rat intestine using the ApopTag ISOL Kit, Protocol One.*

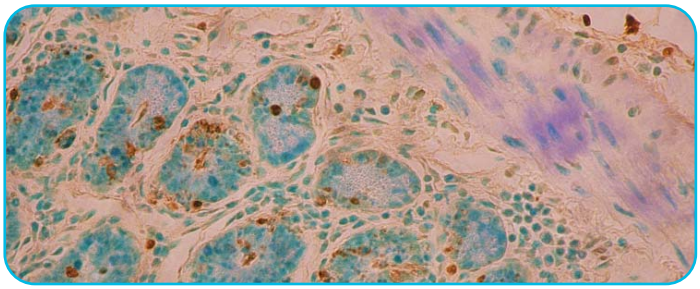
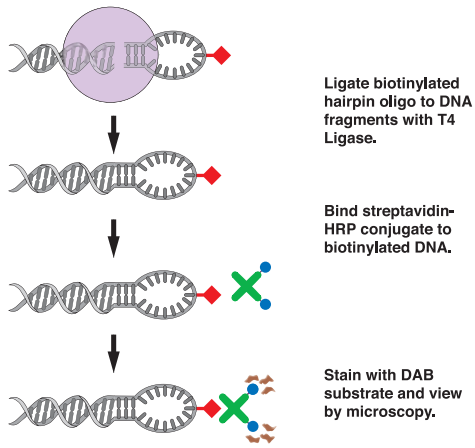


*Figure 15. ApopTag ISOL Technology.*




| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| ApopTag Peroxidase *In Situ* Oligo Ligation (ISOL) Apoptosis Detection Kit | 40 assays | S7200 | $475 |

## Apo-Direct Flow Cytometry Apoptosis Detection Kit

The Chemicon Apo-Direct Kit from Millipore is a single-step staining method for labeling DNA breaks to detect apoptotic cells by flow cytometry. The kit contains all the reagents required for measuring apoptosis in cells including positive and negative control cells; washing, reaction and rinsing buffers; and propidium iodide/RNase A solution for counter staining the total DNA.

| | | | |
|---|---|---|---|
| Apo-Direct Flow Cytometry Apoptosis Detection Kit | 50 assays | APT110 | $520 |

## ApopTag TUNEL Apoptosis Detection Kits

One of the hallmarks of apoptosis is DNA fragmentation. Chemicon's ApopTag Apoptosis Detection Kits from Millipore detect apoptotic cells *in situ* by specific end-labeling of those DNA fragments using the TUNEL method. Nucleotides labeled with either digoxigenin or fluorescein (see Figure 16) are enzymatically added to 3'-hydroxyl DNA ends by terminal deoxynucleotidyl transferase (TdT). This enzyme is more selective for DNA fragments from apoptotic rather than necrotic cells and is more specific than DNA polymerase. The incorporated nucleotides form a random heteropolymer in a ratio that is optimized to promote anti-digoxigenin antibody binding or to minimize fluorescein self-quenching. The anti-digoxigenin antibody fragment carries either a conjugated reporter enzyme (peroxidase, see Figure 17) or one of two fluorescent molecules, fluorescein or sulforhodamine, to the reaction site. The localized peroxidase enzyme catalytically generates an intense signal from chromogenic substrates that can be observed using light microscopy. Alternatively, the bound fluorescein or sulforhodamine may be observed by flow cytometry or fluorescence microscopy. (Analysis of sulforhodamine by flow cytometry requires the use of special filters in the flow cytometer.)

In the direct labeling strategy (used in Cat. No. S7160), the antibody detection steps are eliminated, and nucleotides labeled with fluorescein are directly incorporated into the DNA. These specimens may be analyzed by flow cytometry or fluorescent microscopy.

### ApopTag Advantages

**Flexible:** Choice of detection methods (flow cytometry or microscopy)

**Versatile:** Peroxidase, fluorescein or rhodamine kits available

**Accuracy:** Control slides available to monitor and confirm accuracy

**Reliable:** Hundreds of citations in peer-reviewed journals

*Figure 16. ApopTag Fluorescein Principle.*

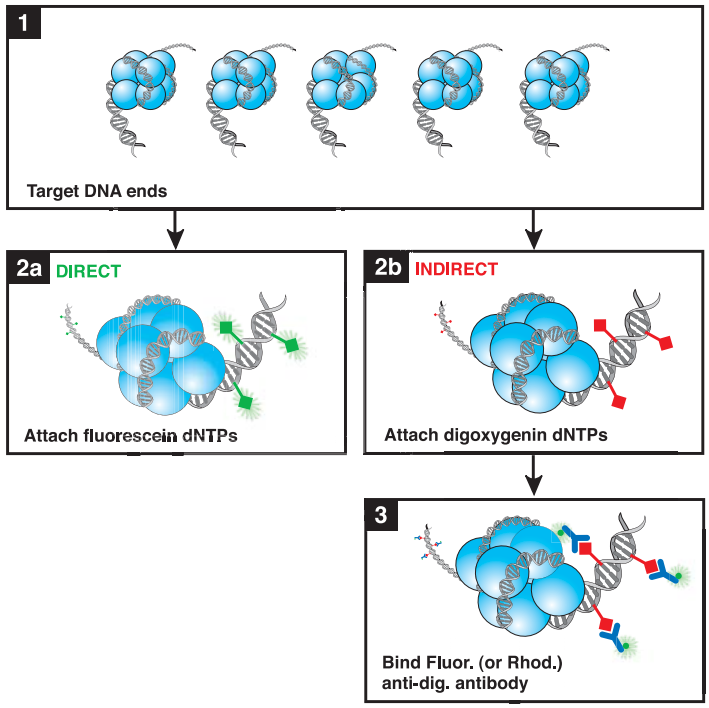
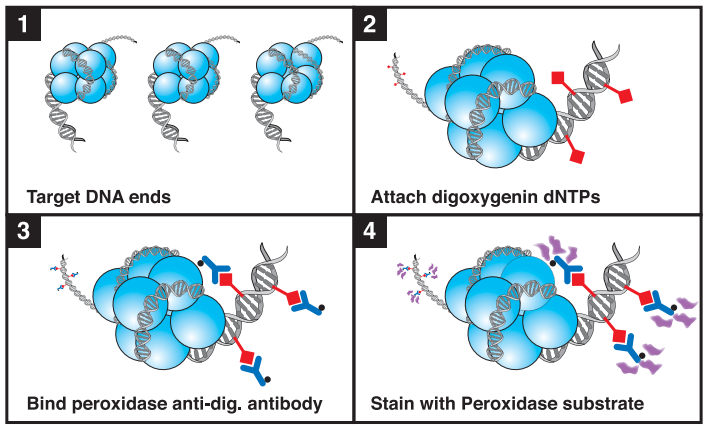



*Figure 17. ApopTag Peroxidase Principle.*



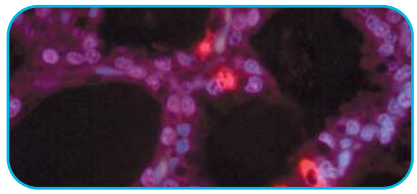

| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| ApopTag Peroxidase *In Situ* Apoptosis Detection Kit | 40 assays | S7100 | $380 |
| ApopTag Plus Peroxidase *In Situ* Apoptosis Detection Kit | 40 assays | S7101 | $430 |
| ApopTag Fluorescein *In Situ* Apoptosis Detection Kit | 40 assays | S7110 | $405 |
| ApopTag Plus Fluorescein *In Situ* Apoptosis Detection Kit | 40 assays | S7111 | $415 |
| ApopTag Fluorescein Direct *In Situ* Apoptosis Detection Kit | 40 assays | S7160 | $385 |
| ApopTag Red *In Situ* Apoptosis Detection Kit | 40 assays | S7165 | $390 |

**Table 3:** ApopTag TUNEL Kit Components

| Description | Cat. No. | Buffers* & Coverslips | Blocking Solution | Anti-Digoxigenin-Peroxidase Antibody | Anti-Digoxigenin-Fluorescein Antibody | Anti-Digoxigenin-Rhodamine Antibody | Positive Control Slides | DAB Substrate |
|---|---|---|---|---|---|---|---|---|
| ApopTag Peroxidase | S7100 | ● | | ● | | | | |
| ApopTag PLUS Peroxidase | S7101 | ● | | ● | | | ● | ● |
| ApopTag Fluorescein | S7110 | ● | ● | | ● | | | |
| ApopTag PLUS Fluorescein | S7111 | ● | ● | | ● | | ● | |
| ApopTag Fluorescein Direct | S7160 | ● | | | | | | |
| ApopTag Fluorescein | S7165 | ● | ● | | | ● | | |

**Equilibration Buffer, Reaction Buffer, TdT Enzyme, Stop/Wash Buffer*

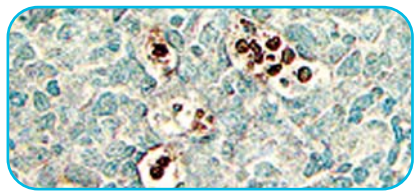
*Figure 18. Detection of apoptotic cells with ApopTag Red in human lymph node tissue, fixed with 10% neutral-buffered formalin and paraffin-embedded.*



## Individual Kit Components

| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| ApopTag Equilibration Buffer | 15 mL | S7105 | $115 |
| ApopTag Plastic Coverslips | 1000 ea | S7117 | $255 |
| ApopTag Positive Control Slides | 5 slides | S7115 | $65 |
| ApopTag Reaction Buffer | 1 mL | S7105 | $115 |
| ApopTag Stop/Wash Buffer | 20 mL | S7108 | $49 |
| ApopTag TdT Enzyme | 300 µL | S7107 | $115 |

*Figure 19. Detection of apoptotic cells in human lymph node with ApopTag Peroxidase. The tissue was fixed in 10% neutral-buffered formalin and paraffin-embedded.*



## Ancillary Products

| | | | |
|---|---|---|---|
| DAPI/Antifade Solution | 1 mL | S7113 | $60 |
| Propidium Iodide Solution | 1 mL | S7109 | $60 |
| Propidium Iodide/Antifade Solution | 1 mL | S7112 | $60 |

## CleavaLite Caspase-3 Activity Assay Kits

Chemicon's CleavaLite Caspase-3 Activity Assay Kit from Millipore provides a highly sensitive assay employing CleavaLite, a novel bioluminescent substrate specific for Caspase-3. CleavaLite is a Renilla luciferase mutant containing the Caspase-3 cleavage site, DEVD. Upon cleavage, it exhibits significantly decreased bioluminescence relative to the amount of Caspase-3. As shown in Figure 20, CleavaLite is highly specific for Caspase-3.

### CleavaLite Caspase-3 Advantages

**Sensitive:** 50 to 100 times more sensitive than standard colorimetric assays

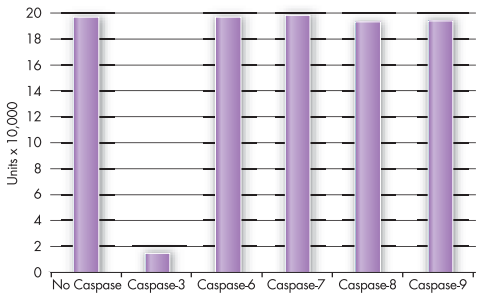
**Fast:** Obtain results in about 2 hours

**Convenient:** 96-well or 384-well format

**Highly Specific:** Only detects Caspase-3

*Figure 20. Cleavage of Bioluminescent Substrate by Caspase-3 Decreases Bioluminescence.*


*Figure 21. CleavaLite Incubated with Various Caspases (0.5 Units of Each).*




| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| CleavaLite Caspase 3 Activity Kit | 96 test | APT300 | $435 |
| CleavaLite Caspase 3 Activity Kit | 384 test | APT301 | $550 |

## Other Caspase Activity Assay Kits

Caspase Colorimetric and Fluorometric Kits provide a simple means for assaying caspase activity. The colorimetric assay is based on spectrophotometric detection of a chromophore following cleavage from a labeled substrate. The fluorometric assay is based on detection of cleavage of a fluorescently labeled substrate. Comparison of the colorimetric or fluorescent signal from an apoptotic sample with an uninduced control allows determination of the fold increase in caspase activity.

| | | | |
|---|---|---|---|
| Caspase 1 Colorimetric | 100 assays | APT161 | $475 |
| Caspase 1 Fluorometric | 100 assays | APT160 | $500 |
| Caspase 2 Colorimetric | 100 assays | APT163 | $475 |
| Caspase 2 Fluorometric | 100 assays | APT162 | $500 |
| Caspase 3 Colorimetric | 25 assays | APT131 | $205 |
| Caspase 3 Colorimetric | 100 assays | APT165 | $390 |
| Caspase 3 Fluorometric | 130 assays | 17-198 | $349 |
| Caspase 5 Colorimetric | 100 assays | APT167 | $475 |
| Caspase 5 Fluorometric | 100 assays | APT166 | $500 |
| Caspase 6 Colorimetric | 100 assays | APT169 | $475 |
| Caspase 6 Fluorometric | 100 assays | APT168 | $500 |
| Caspase 8 Colorimetric | 25 assays | APT129 | $205 |
| Caspase 8 Colorimetric | 100 assays | APT171 | $390 |
| Caspase 8 Fluorometric | 100 assays | APT170 | $500 |
| Caspase 9 Colorimetric | 100 assays | APT173 | $390 |
| Caspase 9 Fluorometric | 100 assays | APT172 | $500 |
| Caspase 10 Colorimetric | 100 assays | APT176 | $475 |
| Caspase 10 Fluorometric | 100 assays | APT174 | $500 |

# Apoptosis and Histones

## H2A.X and H2B

### The Role of Histone Modifications in Apoptosis and DNA Damage

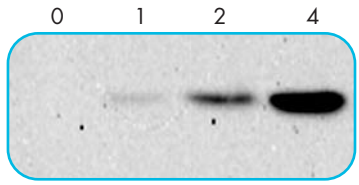
Many key scientific discoveries have been made that link specific histone modifications with important biological phenomena. In particular, several histone modifications have been discovered that are useful biomarkers of apoptosis and DNA damage. Reagents and kits specific for these modifications are of great value to any researcher studying these processes.

Apoptosis is defined as a growth-limiting regulatory mechanism by which cells can trigger their own demise due to advanced age in response to extracellular signals or as a result of irreparable cellular or DNA damage.

Many key regulators of apoptosis are critical to cancer development, as the function of one or more apoptotic inducers (e.g., p16, p53, BRCA1) is lost in most types of cancer. The loss of these key growth checkpoint proteins allow cells to become immortalized by escaping important regulatory growth restrictions. Additionally, some genes that normally function to block premature apoptosis are hyperactivated in specific cancers (Bcl2), thus preventing cells from terminating their growth. Apoptosis is also an important developmental mechanism, such as preventing the overgrowth of particular neuronal cell lineages in the developing brain.

*Figure 22: H2A.X Phosphorylation During Apoptosis.* ***Immunofluorescence of HeLa cells using Anti-phospho-Histone H2A.X (Ser139), clone JBW301 (Cat. No. 05-636). Cells were treated with 1 µg/ml Staurosporine for two hours to induce DNA damage and apoptosis. Left panel, Anti-phospho-H2A.X (Ser139), FITC conjugate (Cat. No.16-202A). Middle panel, DNA stained with DAPI. Right panel, phase contrast image.***

*Figure 23: H2A.X Phosphorylation Western Blot.* ***Western blot using Anti-phospho-Histone H2A.X (Ser139), clone JBW301 (Cat. No. 05-636) antibody at 1:2000 dilution to detect accumulation of g-H2A.X in Jurkat cells treated with 1 µg/ml staurosporine to induce apoptosis. Cells were harvested after the number of hours indicated above each lane.***




## Apoptosis and DNA Damage Related Products

### Antibodies

| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| Anti-phospho-Histone H2A.X (Ser139), clone JBW301 | 200 µg | 05-636 | $349 |
| Anti-phospho-H2A.X (Ser139) | 200 µg | 07-164 | $319 |
| Anti-phospho-Histone H2B (Ser14) | 200 µL | 07-191 | $319 |
| Anti-phospho-Histone H2B (Ser14), clone MC603 | 100 µg | 05-751 | $329 |
| Anti-phospho-Histone H2A.X (Ser139), clone JBW301, biotin conjugate | 100 µg | 16-193 | $359 |

### Active Caspase Detection Kits

| | | | |
|---|---|---|---|
| TUNEL Apoptosis Detection Kit | 1 kit | 17-141 | $475 |
| H2A.X Phosphorylation Assay Kit (Chemiluminescence Detection) | 1 kit | 17-327 | $509 |
| H2A.X Phosphorylation Assay Kit (Flow Cytometry) | 1 kit | 17-344 | $429 |

### Antibodies to Apoptosis Specific Cleavage Products

| | | | |
|---|---|---|---|
| Fas Ligand, Membrane Bound | 1 vial | 01-210 | $309 |
| Staurosporine | 200 µg | 19-123 | $179 |

## H2A.X Phosphorylation as a Biomarker for DNA Damage and Apoptosis

Many agents, such as ionizing radiation and DNA-binding drugs, cause damage to nuclear DNA – the most severe type being double-strand breakage (DSB). DSBs must be repaired quickly and with high fidelity, as they can lead to rearrangements in the genome through recombination. Specific protein complexes exist within the nucleus for just this purpose. The process of apoptosis occurs in successive stages, each with characteristic changes in cell morphology. Along with these changes, specific post-translational modifications occur on the histones. The histone variant H2A.X is rapidly phosphorylated at serine 139 by the ATM kinase in response to even a few double strand DNA breaks. The accumulation of high levels of H2A.X phosphorylation resulting from severe DNA damage is a very early and accurate indicator of apoptosis. Interestingly, H2A.X phosphorylation also occurs when chromosomal DNA is cleaved intentionally, such as during meiotic recombination between sister chromatids and immunoglobulin gene VDJ recombination. The detection of H2A.X phosphorylation is illustrated in Figure 25.


References

1. Rogakou, E. P. *et al., J. Biol. Chem.*, **273**: 5858-5868, 1998.
2. Rogakou, E. P. *et al., J. Cell. Biol.*, **146**: 905-916, 1999.
3. Talasz, H. *et al., Cell Death Differ.*, **9**: 27-39, 2002.
4. Rogakou, E. P. *et al., J. Biol. Chem.*, **275**: 9390-9395, 2000.
5. Paull, T. T. *et al., Curr. Biol.*, **10**: 886-895, 2000.


## H2B Phosphorylation as a Biomarker of Irreversible Commitment to Apoptosis

Another modification, phosphorylation of serine 14 on histone H2B, occurs at the stage in apoptosis when the condensed nuclear DNA is cleaved by caspase-associated DNase enzymes. It is a hallmark of a cell irrevocably committed to the apoptotic pathway. H2A.X phosphorylation is also observed during this stage as a result of the DNase-induced DNA breaks. A third phosphorylation event linked to apoptosis, at serine 32 of histone H2B, has also been reported. Upstate antibodies from Millipore that recognize these modifications, by themselves or as part of kits, are extremely useful in monitoring DNA damage and apoptosis.


References

1. Cheung, W. *et al., Cell*, **113**: 507-517, 2003.

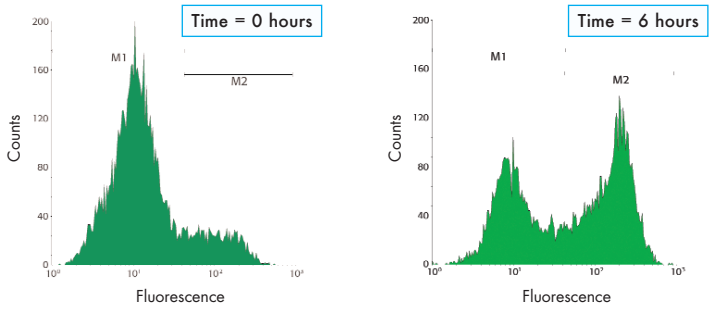




*Figure 24: H2A.X Phosphorylation Assay, FACS. Log phase Jurkat cells were treated with staurosporine (1 µg/ml) for the indicated time. Histone H2A.X (Ser139) phosphorylation was detected using the H2A.X Phosphorylation Assay Kit for Flow Cytometry (Cat. No.17-344), and the cells were analyzed on a Becton-Dickinson FACSCalibur™ flow cytometer.*

*Figure 25. Detection of Histone H2B phosphorylated at serine 14 with Anti-phospho-Histone H2B (Ser14) (Cat. No. 07-191) by immunofluorescence in HL-60 cells stimulated to undergo apoptosis by treatment with VP-16. Top panel, Anti-phospho-Histone H2B (Ser14) (Cat. No. 07-191) staining. Bottom panel, DAPI staining. Note the distinctive morphology of the nuclear DNA as it breaks down, concomitant with the detection of H2B serine 14 phosphorylation (arrows). Courtesy David Allis, The Rockefeller University.*

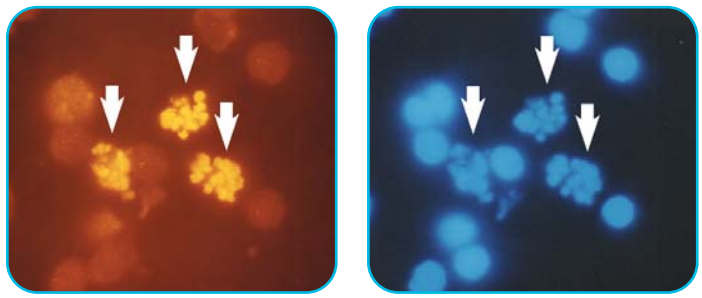
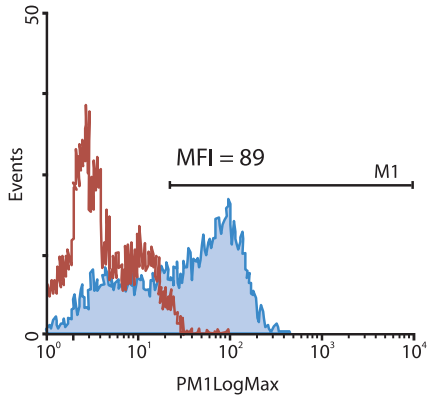


*Figure 26. HL-60 cells were cultured with 20 µg/ml of etoposide for 18 hours. Cells were aliquoted at 3 X $10^5$ per well into a 96-well round-bottom microtiter plate, permeabilized with a buffer containing Tween®-20 and stained with 20 µg/ml of Anti-phospho-Histone H2B (Ser14), clone MC603 (Cat. No. 05-751) (filled histogram) or 20 µg/ml of Normal Rabbit IgG (Cat. No. 12-370) (open histogram) followed by a goat anti-rabbit IgG (H+L) phycoerythrin conjugate. Data was acquired and analyzed using a Guava® PCA-96 System.*



# Biotools Spotlight

## Visualizer™

### A Flexible Family of Western Blot Detection Kits – Discover More and Publish Faster™

Every assay is different. Whether you need a quality reagent for routine detection or require a high sensitivity kit for low protein concentrations, Millipore offers the perfect choice. With the right reagent, you can increase your signal and decrease your background so that you can discover more and publish faster.

#### Low cost, everday use reagents

Upstate Visualizer EC Western Blot Detection Kits from Millipore are designed with a high glow reaction chemiluminescent substrate with outstanding sensitivity, long-lasting signal and low cost. Visualizer EC offers the highest signal-to-noise ratios of any existing luminol peroxidase formulations on the market, resulting in high sensitivity and low backgrounds at an economical price (see Figure 27 below).

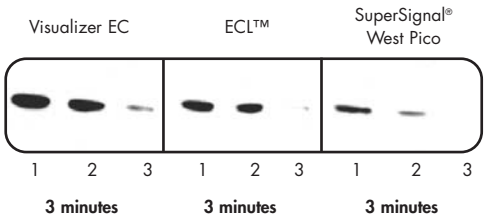
Visualizer Spray & Glow™ is a simple, but novel, enhanced chemiluminescent (ECL) detection reagent with the "at-home" convenience of a spray bottle! Spray the Western membrane and detect your target protein using standard detection methods, without the mixing of substrate and enhancer solutions. The new Upstate Visualizer Spray & Glow ECL Western Blotting Detection System from Millipore will revolutionize Western blotting detection by putting everything you need for a high glow reaction chemiluminescent substrate together in one bottle.

#### High sensitivity reagents for difficult to detect proteins

Upstate Visualizer Western Blot Detection Kits from Millipore, mouse and rabbit, are designed to make Western detection of proteins easier by providing the highest level of sensitivity with the least amount of background. This means less effort optimizing exposure times, and for hard to detect proteins needing long exposures, significantly lower background (see Figure 27 below). Visualizer Western Blot Detection Kits utilize a superior version of the chemiluminescent HRP substrate luminol that results in the fastest and most sensitive detection, a long-lasting signal and the highest signal-to-noise ratio. Kits include chemiluminescent substrates paired with an HRP-conjugated secondary antibody to either rabbit or mouse IgG. Combined with Millipore's extensive line of Upstate and Chemicon primary antibodies, Visualizer Western Blot Detection Kits provide you with the quality results you require for your research. For more information, please visit www.millipore.com/upstate.

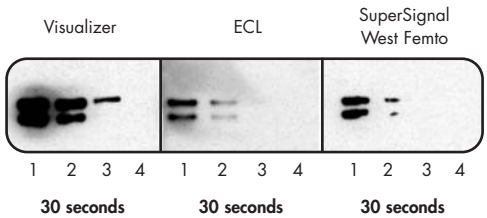
*Figure 27: Western Blot Detection Kit Product Comparison.*

**Visualizer EC – MEK 1 (Cat. No. 06-269)**




*Visualizer EC Western Blot: A 4-12% Bis-Tris SDS-PAGE gel in MOPS buffer was loaded and electrophoresed with HeLa Cell Lysate (Cat. No. 12-501) in a dilution series; 10 µg, 5 µg and 2 µg (lanes 1-3 respectively), and transferred to PVDF membrane. The membrane was cut, and antibody incubations were performed according to each reagent manufacturers' guidelines. Each blot was incubated in the detection reagent as listed and laid side-by-side for 3 minutes exposure to film.*

**Visualizer – MAP Kinase 1/2 (Cat. No. 06-182)**




*Visualizer Western Blot: A 4-12% Bis-Tris SDS-PAGE gel in MOPS buffer was loaded and electrophoresed with Jurkat Cell Lysate (Cat. No. 12-303) in a dilution series; 500 ng, 250 ng, 100 ng and 50 ng (lanes 1-4 respectively), transferred to PVDF membrane. The membrane was cut, and antibody incubations were performed according to each reagent manufacturers' guidelines. Each blot was incubated in the detection reagent as listed and laid side-by-side for 30 seconds exposure to film.*

## Visualizer Family of Western Blot Detection Kits

### Visualizer Spray & Glow Products

| Description | Quantity | Cat. No. | Price |
|---|---|---|---|
| New Visualizer Spray & Glow ECL Western Blotting Detection System | 40 mL Spray Bottle (20 mini-gel-sized blots) | 17-373SP | $59 |
| New Visualizer Spray & Glow ECL Western Blotting Detection System | 100 mL Spray Bottle (50 mini-gel-sized blots) | 17-373 | $149 |
| New Visualizer Spray & Glow ECL Western Blotting Detection System | 3 X 100 mL Spray Bottles (150 mini-gel-sized blots) | 17-373BP | $359 |

### Visualizer EC Products

| | | | |
|---|---|---|---|
| New Visualizer EC Western Blot Detection Kit | 5 mini-blots | 64-301SP | $49 |
| New Visualizer EC Western Blot Detection Kit | 20 mini-blots | 64-301 | $99 |
| New Visualizer EC Western Blot Detection Kit | 50 mini-blots | 64-301BP | $149 |

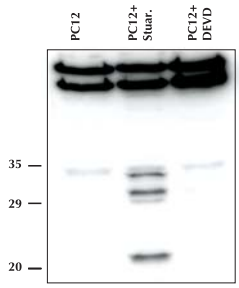
### Visualizer Products

| | | | |
|---|---|---|---|
| Visualizer Western Blot Detection Kit, mouse | 5 mini-blots | 64-201SP | $95 |
| Visualizer Western Blot Detection Kit, mouse | 20 mini-blots | 64-201 | $249 |
| New Visualizer Western Blot Detection Kit, mouse | 50 mini-blots | 64-201BP | $359 |
| Visualizer Western Blot Detection Kit, rabbit | 5 mini-blots | 64-202SP | $95 |
| Visualizer Western Blot Detection Kit, rabbit | 20 mini-blots | 64-202 | $249 |
| New Visualizer Western Blot Detection Kit, rabbit | 50 mini-blots | 64-202BP | $359 |

# Apoptosis and Neuroscience

A prominent feature of Alzheimer's Disease is the formation of senile plaques, composed mainly of Amyloid-β, in selected regions of the brain. Amyloid-β is neurotoxic at high concentrations, and its precursor, Amyloid-β precursor (APP), is directly and efficiently cleaved by caspases 3, 6, 8 and 9 during apoptosis (Barnes *et al.*, 1998; Gervais *et al.*, 1999; LeBlanc *et al.*, 1999; Pelligrini *et al.*, 1999; Weidemann *et al.*, 1999; Lu *et al.*, 2000). *In vitro*, Amyloid-β-induced apoptosis is mediated by the activation of caspase-3 (Marin *et al.*, 2000). The proteolytic cleavage of APP by caspase-3 generates a novel epitope at the carboxy-terminal part of the APP protein. In dying neurons of Alzheimer's Disease brains, the levels of caspase-3 are elevated and there is co-localization of the caspase-3-generated APP cleavage product and Ab in senile plaques (Gervais *et al.*, 1999).

*Figure 28. Rabbit anti-Caspase-Cleaved Amyloid Precursor Protein (Cat. No. AB5942) Western blot of PC12 cells, PC12 cells treated with Staurosporine to induce apoptosis and PC12 cells treated with DEVD (a caspase inhibitor).*




| | | | |
|---|---|---|---|
| Caspase-cleaved Amyloid-β Precursor Protein | 100 µg | AB5942 | $320 |
| Amyloid Precursor Protein, C-terminus | 100 µL | AB5352 | $240 |
| Amyloid Precursor Protein, Universal | 100 µL | AB5300 | $240 |

# Apoptosis Products

**Note:** Additional species and applications may apply. Call Tech Support at 800 437 7500 for more information.

## Tested Applications

| Abbr. | Description | Abbr. | Description | Abbr. | Description |
|---|---|---|---|---|---|
| ABA | Affinity Binding Assay | HDAC | Histone Deacetylase Assay | NEUT | Neutralizing |
| ACT | Activity Assay | HI | Hemagglutination Inhibition | NT | Nitration |
| ADH | Stimulates ECM Adhesion | HMT | Histone Methyltransferase Assay | NUEX | Nuclear Extraction |
| AI | Agonist or Inhibitor | IAP | Immunoaffinity Purification | PA | Phosphatase Assay |
| AMP | DNA Amplification | IC | Immunocytochemistry (Cells) | PC | Positive Control |
| APA | Affinity Precipitation Assay | ID | Immunodiffusion | PCU | Protein Clean-up |
| BD | Beadlyte® Assay | IEP | Immunoelectrophoresis | PD | Protein Determination |
| CA | Caspase Assay | IF | Immunofluorescence | PIA | Peptide Inhibition Assay |
| CC | Culture Confirmation | IFIX | Immunofixation | RIA | Radioimmunoassay |
| ChIP | Chromatin Immunoprecipitation | IH | Immunohistochemistry (Tissue) | RNAi | RNAi/siRNA/Gene Knockdown |
| CULT | Cell Culture | IH(P) | Immunohistochemistry (Paraffin) | RPA | Ribonuclease Protection Assay |
| DB | Dot Blot | IND | Induces Function | RT-PCR | Reverse Transcriptase Polymerase Chain Reaction |
| EA | Enzyme Assay | INHIB | Inhibits Activity/Function | SW | Software Needed |
| ELISA | Enzyme Immunoassay (ELISA) | IP | Immunoprecipitation | TFX | Transfection |
| EM | Electron Microscopy | IPK | IP-Kinase Assay | UC | Uncharacterized Antiserum |
| EMSA | Electrophoretic Mobility Shift Assay | IPX | Immunoperoxidase Staining | WB | Immunoblotting (Western) |
| FC | Flow Cytometry (FACS) | IRMA | Immuno Radio-Metric Assay | Web* | Important additional product reactivity information available on datasheet |
| FUNC | Affects Function | IT | Immunotoxin | | |
| GPA | G-Protein Assay | KA | Kinase Assay | | |
| HA | Hemaglutination | LFA | Lateral Flow Assay | | |
| HAT | Histone Acetyltransferase Assay | NB | Northern Blot | | |

## Tested Species Reactivity

| Abbr. | Description | Abbr. | Description | Abbr. | Description |
|---|---|---|---|---|---|
| A | All Species | Gr | Gerbil | R | Rat |
| Am | Amphibian | Gs | Ground Squirrel | Rb | Rabbit |
| As | *Aspergillus* | Gt | Goat | Rc | Raccoon |
| Av | Avian | H | Human | rH | Recombinant Human Protein |
| B | Bovine | H-sp | Human Only | Rp | Reptilian |
| Bab | Baboon | Ht | Hamster | Sal | Salamander |
| Bact | Bacterial | In | Insect | Seal | Seal |
| Bat | Bat | Inv | Invertebrates | Sh | Sheep |
| Ca | Canine (Dog) | Kn | Kangaroo | Shk | Shark |
| Ch | Chicken | Lg | *Ligia* | SHm | Syrian Hamster |
| Chp | Chimpanzee | Lz | Lizard | Shp | Shrimp |
| Crb | Crab | M | Mouse | Sj | *Schistosoma japonicum* |
| Crf | Crawfish | Ma | Mammals | Sn | Snail |
| Di | *Dictyostelium* | Md | Mule Deer | Snk | Snake |
| Dr | *Drosophila* | Mi | Mink | Spd | Spider |
| Ec | *E. coli* Bacteria | Mk | Monkey | Sqd | Squid |
| Ech | Echinoderms | Ml | Mollusk | Su | Sea Urchin |
| Ecl | *Enterobacter cloacae* | Nem | Nematode | T | *Tetrahymena* |
| Elk | Elk | Nr | *Neurospora crassa* | Vo | Vole |
| Eq | Equine (Horse) | Op | Opposum | Vrt | Vertebrates |
| Eu | Eukaryote | Ox | Ox | WR | Most common vertebrate species tested |
| F | Fish | Pl | Green Plants | Xn | *Xenopus* |
| Fe | Feline (Cat) | Pm | Primate | Y | Yeast (*S. cerevisiae*) |
| Fg | Frog | Pn | *Penicillium* | Zf | Zebra Fish |
| Ft | Ferret | Po | Porcine (Pig) | | |
| Gp | Guinea Pig | Qu | Quail | | |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **Akt/PKB** (see page 8 for a product spotlight on Akt/PKB) | | | | | | |
| Anti-Akt/PKB, PH Domain, clone SKB1 | H M R | WB IP IPK FC | M IgG | 100 µg | 05-591 | $329 |
| Anti-Akt/PKB, PH Domain, agarose conjugate | H M R | IP IPK | | 100 µg | 16-185 | $329 |
| **Akt1/PKBα** | | | | | | |
| Anti-Akt1/PKBα, PH domain, polyclonal | H M | WB | Rb IgG | 100 µL | 06-885 | $319 |
| Anti-Akt1/PKBα | H M R | WB IPK | Rb IgG | 100 µg | 07-416 | $329 |
| Anti-Akt1/PKBα, clone AW24 | H M R | WB IP | Rb IgG | 100 µL | 05-796 | $319 |
| Anti-phospho-Akt1/PKBα (Thr308) | M | WB IH | Rb IgG | 100 µL | 06-678 | $319 |
| Anti-phospho-Akt1/PKBα (Ser473) | H M | WB | Rb IgG | 200 µg | 07-310 | $309 |
| Anti-Akt1, phospho-specific (Ser473) | H M R | WB ELISA | Rb | 50 µg | AB3132 | $280 |
| Anti-phospho-Akt1/PKBα (Thr308), clone NL50 | H M | WB | Rb IgG | 100 µL | 05-802 | $319 |
| Anti-phospho-Akt1/PKBα (Ser473), clone 11E6 | H M | WB | M $IgG_{1\kappa}$ | 100 µg | 05-669 | $329 |
| Anti-phospho-Akt1/PKBα (Ser473), clone SK703 | H M | WB | Rb IgG | 100 µg | 05-736 | $349 |
| Akt1/PKBα Immunoprecipitation-Kinase Assay Kit | | IP KA | | 1 kit | 17-188 | $419 |
| Akt1/PKBα *SMART*pool® siRNA reagent | H | RNAi | | 5 nmol | M-003000 | $375 |
| siRNA plasmid, pKD™-Akt1/PKBα-v2 | H | RNAi | | 5 µg | 62-041 | $349 |
| Akt1/PKBα cDNA (dominant negative) Expression Kit | | TFX | | 1 kit | 17-252 | $699 |
| Akt1/PKBα cDNA (activated) Expression Kit | | TFX | | 1 kit | 17-253 | $699 |
| Akt1/PKBα cDNA Allelic Pack | | TFX | | 1 kit | 17-254 | $1,369 |
| Akt1/PKBα cDNA (activated) in pUSEamp | | TFX | | 5 µg | 21-151 | $599 |
| Akt1/PKBα cDNA (dominant negative) in pUSEamp | | TFX | | 5 µg | 21-152 | $599 |
| Akt1/PKBα cDNA (wt) in pUSEamp | | TFX | | 5 µg | 21-153 | $599 |
| New Anti-phospho-Akt1 (Thr34) | H | WB ELISA | Rb IgG | 100 µL | 07-789 | $309 |
| **Akt1/PKBβ** | | | | | | |
| Anti-Akt2/PKBβ, clone AW114 | H R | WB IP | Rb IgG | 100 µL | 05-771 | $319 |
| Anti-Akt2/PKBβ | H M R | WB IP | Rb IgG | 200 µg | 07-372 | $319 |
| Akt2/PKBβ *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003001 | $375 |
| siRNA plasmid, pKD-Akt2/PKBβ-v1 | H | RNAi | | 5 µg | 62-103 | $349 |
| **Akt3/PKBγ** | | | | | | |
| Anti-Akt3/PKBg | H | WB IPK | Rb IgG | 100 µL | 07-383 | $329 |
| Anti-Akt3, N-terminus | H M R | WB ELISA | Rb | 50 µg | AB3136 | $260 |
| Anti-Akt3/PKBg, clone GMA104 | H | WB IP | M $IgG_{2a}$ | 100 µg | 05-780 | $319 |
| Akt3/PKBg SMARTpool siRNA reagent | H | RNAi | | 5 nmol | M-003002 | $375 |
| siRNA plasmid, pKD-Akt3/PKBg-v2 | H | RNAi | | 5 µg | 62-138 | $349 |
| **PRAS40 (Proline-Rich Akt Substrate)** | | | | | | |
| New Anti-PRAS40 | H | WB IP | M $IgG_{1\kappa}$ | 200 µL | 05-988 | $309 |
| New Anti-phospho-PRAS40 (Thr246) | H M | WB | Rb IgG | 100 µL | 07-888 | $309 |
| **Annexin** | | | | | | |
| Anti-Annexin I, clone 6E4/3 | H | WB ELISA IF | M $IgG_1$ | 100 µg | MAB3773 | $235 |
| Anti-Annexin II, clone 3D5/4 | H | IP ELISA IH | M $IgG_{2a\kappa}$ | 100 µg | MAB3774 | $235 |
| Apopnexin FITC Apoptosis Kit | Ma | | | 100 assays | APT750 | $380 |
| Apopnexin Biotin Apoptosis Kit | Ma | | | 100 assays | APT700 | $380 |
| **Apaf-1** | | | | | | |
| Anti-Apaf-1, C-terminus | H M R | WB | Rb | 100 µg | AB16503 | $220 |
| Anti-Apaf-1, N-terminus | H M | WB | Rb | 100 µg | AB16941 | $220 |
| Anti-Apaf-1, clone 2E12 | H | WB IP ELISA FC IH | R $IgG_{2a\kappa}$ | 100 µg | MAB3503 | $220 |
| Anti-Apaf-1, clone 13F11 | M | WB IP ELISA FC | R $IgG_{2a\kappa}$ | 100 µg | MAB3504 | $265 |
| Anti-Apaf-1, clone 18H2 | H M | WB IP ELISA FC | R $IgG_{2a\kappa}$ | 100 µg | MAB3505 | $265 |
| **AIF (Apoptosis Inducing Factor)** | | | | | | |
| Anti-AIF | H M R | WB | Rb IgG | 200 µg | 07-208 | $299 |
| Anti-AIF, internal domain | H M R | WB IH(P) Web* | Rb | 100 µg | AB16501 | $220 |
| Anti-AIF, N-terminus | H | WB | Rb | 100 µg | AB16502 | $220 |
| siRNA plasmid, pKD-AIF-v3 | H | RNAi | | 5 µg | 62-128 | $349 |
| AIF Control Peptide | | | | 50 µg | AG622 | $135 |

| | Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|---|
| APRIL | | | | | | | |
| | Anti-APRIL | H | WB | Rb | 100 µg | AB3635 | $205 |
| ARC | | | | | | | |
| | Anti-ARC, N-terminus | H M R | WB | Rb | 100 µg | AB16504 | $220 |
| | Anti-ARC, C-terminus | H | WB | Rb | 100 µg | AB17005 | $220 |
| | Anti-ARC | H M R | WB | Rb | 100 µL | AB4517 | $195 |
| | ARC, control peptide for AB16504 | | PIA | | | AG679 | $145 |
| Arts | | | | | | | |
| | Anti-Arts | H | WB | Rb | 50 µL | AB4512 | $195 |
| AS160 | | | | | | | |
| New | Anti-AS160 (Rab GAP) | H M R | WB | Rb IgG | 200 µL | 07-741 | $269 |
| New | Anti-phospho-AS160 (Thr642) | H M R | WB | Rb IgG | 100 µL | 07-802 | $309 |
| ASC | | | | | | | |
| | Anti-ASC | H WB | | Rb | 100 µg | AB3607 | $220 |
| ASK1 | | | | | | | |
| | Anti-ASK1 | H WB | | Rb IgG | 200 µg | 07-302 | $309 |
| | Anti-ASK-1, C-terminus | H WB | | Rb | 100 µg | AB16505 | $220 |
| Aven | | | | | | | |
| | Anti-Aven | H,M | WB | Rb IgG | 200 µg | 07-640 | $309 |
| Bad | | | | | | | |
| | Anti-Bad | H | WB IP IC | Rb | 100 µL | AB2925 | $205 |
| | Anti-Bad, clone BYC001 | H M | WB IP | M IgG | 200 µg | 05-605 | $329 |
| New | Anti-phospho-Bad (Ser112) | H | | Rb | 100 µL | AB3569 | $315 |
| New | Anti-phospho-Bad (Ser128) | H | | Rb | 100 µL | AB3567 | $315 |
| New | Anti-phospho-Bad (Ser136) | H | | Rb | 100 µL | AB3571 | $315 |
| | Anti-phospho-Bad (Ser155), clone JBW101 | H M R | WB | M $IgG_{2b}$ | 100 µL | 05-628 | $319 |
| | Anti-Bad, phospho-specific (Ser155), clone 27AT381 | H M | WB | M $IgG_1$ | 100 µg | MAB3730 | $295 |
| | Bad, agarose | | KA | | 100 µg | 14-281 | $299 |
| | Bad, soluble | | KA | | 100 µg | 14-357 | $319 |
| | siRNA plasmid, pKD-Bad-v3 | | RNAi | | 5 µg | 62-243 | $349 |
| Baff | | | | | | | |
| | Anti-BAFF, C-terminus | H M R | WB | Rb | 100 µg | AB16530 | $220 |
| | BAFF, recombinant human | | | | 20 µg | GF119 | $220 |
| Bag | | | | | | | |
| | Anti-BAG-1, clone 3.10G3E2 | H | WB IH | M $IgG_1$ | 50 µg | MAB4611 | $210 |
| Bak | | | | | | | |
| | Anti-Bak, NT | H M | WB IP IH | Rb IgG | 200 µg | 06-536 | $329 |
| | APOPTOPAK, (Anti-Bcl2, Bak, Bax) Miniature Set | | WB IP IC IH | | 1 kit | 17-178 | $275 |
| BAR | | | | | | | |
| | Anti-BAR | H | WB IP IH | Rb | 100 µL | AB3530 | $205 |
| | Anti-BarH2 | H M | IH | Rb | 100 µg | AB5720 | $245 |
| | Anti-Barx1 | H M | WB IC IH | Rb | 100 µg | AB5825 | $245 |
| Bax | | | | | | | |
| | Anti-Bax, NT | H M | WB IP IC IH | Rb IgG | 200 µg | 06-499 | $319 |
| | Anti-Bax | M | WB IH(P) | Rb | 100 µL | AB2915 | $255 |
| | Anti-Bax, a.a. 43-61 hBax | H | | Rb | 100 µL | AB2930 | $205 |
| | Anti-Bax, N-terminus, aa3-16 hBax protein, clone 2D2 | H | WB IF IH(P) | M $IgG_1$ | 100 µg | MAB4601 | $290 |
| | Anti-Bax, azide free, clone 2D2 | H | WB IP ELISA IF IH(P) | M $IgG_1$ | 100 µg | MAB4601Z | $290 |
| | APOPTOPAK, (Anti-Bcl2, Bak, Bax) Miniature Set | | WB IP IC IH | | 1 kit | 17-178 | $275 |
| | siRNA plasmid, pKD-Bax-v2 | H | RNAi | | 5 µg | 62-042 | $349 |
| | siRNA plasmid, pKD-Bax-v3 | H M R | RNAi | | 5 µg | 62-132 | $349 |
| | Bax cDNA (wt) in pUSEamp | | TFX | | 5 µg | 21-159 | $599 |

| | Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|---|
| **Bcl2** | | | | | | | |
| | Anti-Bcl-2 | | | Rb | 50 µL | AB1720 | $210 |
| | Anti-Bcl-2, a.a. 68-86 of mBCL2 | M R | | Rb | 100 µL | AB1722 | $205 |
| | Anti-A1 | M | WB IP | Rb | 100 µL | AB3155 | $205 |
| | Anti-Bcl2, clone 100 | H M Ca | WB FC IH | M IgG | 100 µg | 05-729 | $319 |
| | Anti-Bcl2, clone AW604 | H | WB IP | M $IgG_{1a}$ | 200 µg | 05-826 | $319 |
| | Anti-Bcl-2, clone 4D7 | H | IP DB | M $IgG_1$ | 100 µg | MAB2900 | $280 |
| | Anti-phospho-Bcl2 (Ser70), clone CT7 | H | WB IP | Rb IgG | 100 µL | 05-843 | $339 |
| | IHC Select® Anti-Bcl-2, prediluted, clone 124 | H | IH(P) | M $IgG_{1\kappa}$ | 6 mL | IHC2033-6 | $210 |
| | IHC Select Anti-Bcl-2, prediluted, clone 124 | H | IH(P) | M $IgG_{1\kappa}$ | 6 mL | IHCR2033-6 | $210 |
| | APOPTOPAK, (Anti-Bcl2, Bak, Bax) Miniature Set | | WB IP IC IH | | 1 kit | 17-178 | $275 |
| | Bcl-2, Sandwich ELISA | H | ELISA | | 1 kit | APT230 | $525 |
| | Bcl2 *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003307 | $375 |
| | Bcl2 siRNA/siAb™ Assay Kit | H | WB RNAi | | 1 kit | 60-004 | $649 |
| | Bcl2 cDNA (wt) in pUSE amp | | TFX | | 50 µg | 21-158 | $599 |
| **Bcl3** | | | | | | | |
| | Anti-Bcl3 | H | WB IP IC | Rb IgG | 200 µg | 06-415 | $329 |
| | Anti-Bcl-3, clone HAM150-3.5 | H M | WB ELISA | AHmst $IgG_{1l}$ | 100 µL | MAB2350 | $240 |
| | siRNA plasmid, pKD-Bcl3-v1 | H | RNAi | | 5 µg | 62-133 | $349 |
| | siRNA plasmid, pKD-Bcl3-v4 | | RNAi | | 5 µg | 62-233 | $349 |
| **Bcl6** | | | | | | | |
| | Anti-Bcl-6, clone BL6.02 (PG-B6p) | H R Sh Rb B Po | IH(P) | M $IgG_{1\kappa}$ | 250 µL | MAB4618 | $210 |
| **Bcl10** | | | | | | | |
| | Anti-Bcl-10, N-terminus | H | WB | Rb | 100 µg | AB16506 | $195 |
| | Anti-Bcl10, clone 151 | H | WB FC IH | | 100 µL | 05-732 | $319 |
| **BclW** | | | | | | | |
| | Anti-Bcl-W, a.a. 16-29 | H M R B Mk | WB IH(P) Web* | Rb | 50 µg | AB1723 | $210 |
| | Anti-Bcl-W, clone 16H12 | H M | WB IP FC | R $IgG_{2a}$ | 100 µg | MAB17002 | $350 |
| **BclXL/XS** | | | | | | | |
| New | Anti-phospho-Bcl-XL (SerS62) | H | WB | Rb | 100 µL | AB3573 | $315 |
| | Anti-Bcl-XL, Phospho-specific | H | WB | Rb | 100 µL | AB3116 | $290 |
| | Anti-Bcl-XL, N-terminus, clone 7D9 | M | IF FC | M $IgG_{2a}$ | 50 µg | MAB4619 | $210 |
| | Anti-Bcl-XL, clone BXL03 | H | IF | M $IgG_1$ | 50 µg | MAB4620 | $210 |
| | Anti-Bcl-X, clone 2H12 | H M R Po | WB IP IF FC IH | M $IgG_{2a}$ | 50 µg | MAB4625 | $210 |
| | Anti-Bcl-XL and BclXs, clone 7B2.5 | H | WB IP FC IH | M $IgG_3$ | 50 µg | MAB3121 | $210 |
| | Anti-Bcl-XL, clone 7B2.5 | H | FC IH | M | 50 µg | MAB3121B | $210 |
| | Anti-Bcl-XL, clone 7B2.5 | H | FC IH | M | 50 µg | MAB3121F | $235 |
| | Anti-Bcl-XL, clone 7B2.5 | H | FC IH | M | 50 µg | MAB3121P | $250 |
| **BID** | | | | | | | |
| | Anti-BID | H M R | WB IP IH | Rb | 100 µg | AB1730 | $330 |
| | Anti-BID | H M R Rb | WB IP IH | Rb | 100 µL | AB1735 | $205 |
| New | Anti-Mouse BID Cleavage site specific | M | WB | Rb | 100 µL | AB10002 | $315 |
| **Bim** | | | | | | | |
| New | Anti-Bim, internal epitope, pan-Bim isoforms | H M R | WB | Rb | 100 µg | AB17003 | $220 |
| | Anti-phospho-Bim EL (Ser65) | H M R | WB IP | Rb IgG | 200 µg | 36-004 | $319 |
| | Anti-phospho-Bim EL (Ser55) | H | WB | Rb IgG | 200 µg | 36-005 | $319 |
| | Anti-Bim, clone 14A8 | H M | WB IP FC IH | R $IgG_{2a}$ | 250 µg | MAB17001-250UG | $750 |
| | Anti-Bim, clone 14A8 | H M | WB IP FC IH | R $IgG_{2a}$ | 50 µg | MAB17001-50UG | $245 |
| | Anti-BimL, clone 5E.5 | H M | WB IP ELISA FC IH | R $IgG_{2b}$ | 50 µg | MAB3129 | $210 |
| | Anti-BimL, clone 5E.5 | H M | WB IP ELISA FC IH | R $IgG_{2a}$ | 250 µg | MAB3129-250UG | $650 |
| | Bim-GST | | WB KA | | 100 µg | 12-483 | $275 |
| | Bim-GST (3A) | | WB KA | | 100 µg | 12-484 | $275 |
| New | Anti-phospho-Bim EL (Ser69) | H R | WB | Rb | 100 µL | AB3579 | $315 |
| **Bin1** | | | | | | | |
| | Anti-Bin1, clone 99D | H M R | WB IP IH | M $IgG_{1\kappa}$ | 200 µg | 05-449 | $319 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **Blys** | | | | | | |
| Anti-Blys/TALL-1/BAFF/THANK | H | WB | Rb IgG | 100 µg | 07-167 | $319 |
| siRNA plasmid, pKD-Blys-v2 | H | RNAi | | 5 µg | 62-129 | $349 |
| siRNA plasmid, pKD-Blys-v3 | H | RNAi | | 5 µg | 62-130 | $349 |
| **Bnip3L** | | | | | | |
| Anti-Bnip3L, internal | H M | WB | Rb | 100 µg | AB16507 | $220 |
| **CAD** | | | | | | |
| Anti-CAD, C-terminus | M | WB | Rb | 100 µg | AB16925 | $210 |
| **Calpain** | | | | | | |
| Anti-Calpain, small subunit of µ- or m-Calpains (Calpain I or II), clone P1 | H R B | WB ELISA IC IH | M $IgG_1$ | 100 µL | MAB3083 | $190 |
| Anti-Calpain I, large subunit (Calpain I), clone P-6 | H | WB ELISA IC IH | M $IgG_1$ | 100 µL | MAB3082 | $190 |
| Anti-Calpain I, large subunit, clone P9 | H M R Ht Ca | WB IP ELISA IC | M $IgG_1$ | 100 µL | MAB3104 | $190 |
| Anti-Calpain II, large (catalytic) subunit | H | WB ELISA IC IH | Rb | 100 µL | AB1625 | $170 |
| Anti-Calpain II, large subunit | R | WB IP ELISA IH | Rb | 100 µg | AB81013 | $300 |
| Anti-Calpain LP85 and LP82, large subunit | R | WB IP ELISA IH | Rb | 100 µg | AB81011 | $265 |
| Anti-Calpain-94, large subunit, domain IV | H | WB IP ELISA IH | Rb | 100 µg | AB81018 | $300 |
| Anti-Calpain-94, large subunit, domain II | H | WB IP ELISA IH | Rb | 100 µg | AB81019 | $300 |
| **Caspase** | | | | | | |
| **Pan-Caspase** | | | | | | |
| CaspaTag™ Pan-Caspase *In Situ* Assay Kit, Fluorescein | Ma | ACT | | 25 assays | APT420 | $155 |
| CaspaTag Pan-Caspase *In Situ* Assay Kit, Fluorescein | Ma | ACT | | 100 assays | APT400 | $435 |
| CaspaTag Pan-Caspase *In Situ* Assay Kit, Sulforhodamine | Ma | ACT | | 25 assays | APT520 | $185 |
| CaspaTag Pan-Caspase *In Situ* Assay Kit, Sulforhodamine | Ma | ACT | | 100 assays | APT500 | $470 |
| CaspSCREEN, non-adherent cells only | Ma | ACT | | 25 assays | APT105 | $395 |
| Caspase Family Inhibitor Set | Ma | ACT | | 1 kit | APT135 | $265 |
| **Caspase 1** | | | | | | |
| Anti-Caspase 1 | H M R | WB IP IC | Rb IgG | 200 µg | 06-503 | $329 |
| Anti-Caspase 1 | H M R | WB IP IF | Rb | 50 µg | AB1871 | $220 |
| Caspase 1, recombinant human active | | ACT | | 25 units | CC126 | $170 |
| siRNA plasmid, pKD-Caspase 1-v3 | H | RNAi | | 5 µg | 62-131 | $349 |
| siRNA plasmid, pKD-Caspase 1-v2 | H | RNAi | | 5 µg | 62-159 | $349 |
| Caspase 1 Fluorometric Assay Kit, YVAD | Ma | ACT | | 100 assays | APT160 | $500 |
| Caspase 1 Colorimetric Assay Kit, YVAD | Ma | ACT | | 100 assays | APT161 | $475 |
| **Caspase 2** | | | | | | |
| Anti-Caspase 2, clone 10C6 | H M Mk Ca | WB IP ELISA FC | R $IgG_{2a}$ | 100 µg | MAB3501 | $290 |
| Anti-Caspase 2, clone 11B4 | H M Mk Ca | WB IP ELISA FC | R $IgG_{2a}$ | 100 µg | MAB3507 | $290 |
| Anti-Caspase 2, clone 4-1-1 | H | WB | M IgG | 200 µL | 05-711 | $299 |
| Caspase 2 Fluorometric Assay Kit, VDVAD | Ma | ACT | | 100 assays | APT162 | $500 |
| Caspase 2 Colorimetric Assay Kit, VDVAD | Ma | ACT | | 100 assays | APT163 | $475 |
| Caspase 2, recombinant human active | | ACT | | 25 units | CC127 | $185 |
| **Caspase 3** | | | | | | |
| Anti-Caspase 3 | H M R | WB | Rb IgG | 200 µg | 06-735 | $319 |
| Anti-Caspase 3, a.a. 104-117, proform & lrg subunit | H M | WB | Rb | 100 µL | AB3640 | $255 |
| Anti-Caspase 3, large subunit & proform | H M R | WB | Rb | 50 µg | AB1899 | $220 |
| Anti-Caspase 3, active (cleaved) form | H M R | WB IH IH(P) Web* | Rb | 50 µg | AB3623 | $240 |
| Anti-Caspase 3, clone 4-1-18 | H | WB | M $IgG_{2a}$ | 100 µg | 05-654 | $329 |
| Anti-Caspase 3, large subunit & proform, clone 3CSP03 | H | WB IP IH(P) | M $IgG_{2a}$ | 50 µg | MAB4603 | $210 |
| Anti-Caspase 3, large subunit & proform, clone 4-1-18 | H | WB IH(P) | M $IgG_{2a\kappa}$ | 100 µg | MAB4703 | $220 |
| Caspase 3, active | | CA | | 20 µg | 14-264 | $329 |
| Human Caspase 3, recombinant human active | | ACT | | 25 units | CC119 | $115 |
| siRNA plasmid, pKD-Caspase 3-v2 | | RNAi | | 5 µg | 62-245 | $349 |
| siRNA plasmid, pKD-Caspase 3-v3 | | RNAi | | 5 µg | 62-246 | $349 |
| CleavaLite Caspase 3 Activity Assay Kit | Ma | ACT | | 96 assays | APT300 | $435 |
| CleavaLite Caspase 3 Activity Assay Kit | Ma | ACT | | 384 assays | APT301 | $550 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Fluorescein | Ma | ACT | | 25 assays | APT423 | $155 |
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Fluorescein | Ma | ACT | | 100 assays | APT403 | $435 |
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Sulforhodamine | Ma | ACT | | 25 assays | APT523 | $185 |
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Sulforhodamine | Ma | ACT | | 100 assays | APT503 | $490 |
| Caspase 3 Colorimetric Activity Assay Kit, DEVD | Ma | ACT | | 25 assays | APT131 | $205 |
| Caspase 3 Colorimetric Activity Assay Kit, DEVD | Ma | ACT | | 100 assays | APT165 | $390 |
| Caspase 3 Activity Detection Kit | | CA | | 1 kit | 17-198 | $349 |
| Caspase 3/7 Assay Kit (Ac-DEVD-AMC Substrate) | | CA | | 1 kit | 17-367 | $420 |
| **Caspase 5** | | | | | | |
| Caspase 5 Fluorometric Activity Assay Kit, WEHD | Ma | ACT | | 100 assays | APT166 | $500 |
| Caspase 5 Colorimetric Activity Assay Kit, WEHD | Ma | ACT | | 100 assays | APT167 | $475 |
| **Caspase 6** | | | | | | |
| Anti-Caspase 6 | H | WB IP | Rb IgG | 200 µg | 06-691 | $289 |
| Anti-Caspase 6, proform & sm. subunit | H M R Ht Sh Rb B Po Mk Ca | WB | Rb | 50 µg | AB1851 | $210 |
| Caspase 6 Fluorometric Activity Assay Kit, VEID | Ma | ACT | | 100 assays | APT168 | $500 |
| Caspase 6 Colorimetric Activity Assay Kit, VEID | Ma | ACT | | 100 assays | APT169 | $475 |
| **Caspase 7** | | | | | | |
| Anti-Caspase 7, proform & lg. subunit | H | WB | Rb | 100 µL | AB1999 | $220 |
| Anti-Caspase 7, active (cleaved) form | H R | WB | Rb | 50 µg | AB3627 | $220 |
| Anti-Caspase 7, proform & lg. subunit | H | WB | Ch | 100 µL | AB1998 | $240 |
| Anti-Caspase 7, clone 7-1-11 | H | WB IP | M IgG | 100 µg | 05-578 | $319 |
| Anti-Caspase 7, clone 10-1-62 | H | WB | M | 100 µg | MAB4707 | $210 |
| Caspase 7, recombinant human active | H | Act | | 25 units | CC125 | $170 |
| Caspase 7, active | | CA | | 25 units | 14-398 | $289 |
| siRNA plasmid, pKD-Caspase 7-v1 | H | RNAi | | 5 µg | 62-004 | $349 |
| siRNA plasmid, pKD-Caspase 7-v3 | H | RNAi | | 20 µg | 62-005 | $349 |
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Fluorescein | Ma | ACT | | 25 assays | APT423 | $155 |
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Fluorescein | Ma | ACT | | 100 assays | APT403 | $435 |
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Sulforhodamine | Ma | ACT | | 25 assays | APT523 | $185 |
| CaspaTag Caspase 3,7 *In Situ* Assay Kit, Sulforhodamine | Ma | ACT | | 100 assays | APT503 | $490 |
| Caspase 3/7 Assay Kit (Ac-DEVD-AMC Substrate) | | CA | | 1 kit | 17-367 | $420 |
| **Caspase 8** | | | | | | |
| Anti-Caspase 8 | H | WB | Rb IgG | 200 µg | 06-775 | $319 |
| Anti-Caspase 8 | H M R B Mk | WB | Rb | 50 µg | AB1879 | $220 |
| Anti-Caspase 8, a.a. 410-424 | H | WB | Rb | 100 µL | AB3641 | $255 |
| Anti-Caspase 8, clone 1-1-37 | H | WB IP | M IgG | 100 µg | 05-573 | $309 |
| Anti-Caspase 8, clone C51S | H | WB IP | M $IgG_{2a}$ | 50 µg | MAB3508 | $200 |
| Anti-Caspase 8, clone 8CSP01 | H | WB | M $IgG_{1\kappa}$ | 50 µg | MAB4608 | $200 |
| Anti-Caspase 8, clone 1-1-37 | H | WB | M Ig | 100 µg | MAB4708 | $215 |
| Caspase 8, recombinant human active | H | ACT | | 25 units | CC123 | $170 |
| siRNA plasmid, pKD-Caspase 8-v1 | H | RNAi | | 5 µg | 62-145 | $349 |
| siRNA plasmid, pKD-Caspase 8-v3 | | RNAi | | 5 µg | 62-190 | $349 |
| CaspaTag Caspase 8 *In Situ* Assay Kit, Fluorescein | | ACT | | 25 assays | APT428 | $155 |
| CaspaTag Caspase 8 *In Situ* Assay Kit, Fluorescein | | ACT | | 100 assays | APT408 | $440 |
| Caspase 8 Colorimetric Activity Assay Kit, IETD | Ma | ACT | | 25 assays | APT129 | $205 |
| Caspase 8 Fluorometric Activity Assay Kit, IETD | Ma | ACT | | 100 assays | APT170 | $500 |
| Caspase 8 Colorimetric Activity Assay Kit, IETD | Ma | ACT | | 100 assays | APT171 | $390 |
| **Caspase 9** | | | | | | |
| Anti-Caspase 9, proform & lg. subunit | H M R | WB | Rb | 100 µg | AB16969 | $220 |
| Anti-Caspase 9, proform & sm. subunit | H M | WB | Rb | 100 µg | AB16970 | $220 |
| Anti-Caspase 9, active (cleaved) form | H | WB IP IC | Rb | 50 µg | AB3629 | $240 |
| New Anti-Caspase 9 cleavage site specific (315/316) | H | WB IC | Rb | 100 µL | AB3577 | $315 |
| Anti-Caspase 9, clone 96-2-22 | H | WB | M IgG | 100 µg | 05-572 | $329 |
| Anti-Caspase 9, clone 9CSP02 | H | WB IP IH | M $IgG_{1\kappa}$ | 50 µg | MAB4609 | $210 |
| Anti-Caspase 9, clone 2-23 | H | WB IP IH(P) | M $IgG_1$ | 100 µg | MAB4709 | $220 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| Caspase 9, recombinant human active | H | ACT | E. Coli | 25 units | CC120 | $155 |
| CaspaTag Caspase 9 *In Situ* Assay Kit, Fluorescein | | ACT | | 25 assays | APT429 | $155 |
| CaspaTag Caspase 9 *In Situ* Assay Kit, Fluorescein | | ACT | | 100 assays | APT409 | $440 |
| Caspase 9 Fluorometric Activity Assay Kit, LEHD | Ma | ACT | | 100 assays | APT172 | $500 |
| Caspase 9 Colorimetric Activity Assay Kit, LEHD | Ma | ACT | | 25 assays | APT139 | $195 |
| Caspase 9 Colorimetric Activity Assay Kit, LEHD | Ma | ACT | | 100 assays | APT173 | $390 |
| **Caspase 10** | | | | | | |
| Anti-Caspase 10 | H Ca | WB IP IH | Rb | 100 µL | AB1010 | $205 |
| Anti-Caspase 10, C-terminus, proform & sm. subunit | H | WB | Rb | 100 µg | AB16960 | $220 |
| Caspase 10, recombinant human active | H | ACT | | 25 units | CC128 | $185 |
| Caspase 10 Fluorometric Assay Kit, AEVD | Ma | ACT | | 25 assays | APT148 | $210 |
| Caspase 10 Fluorometric Assay Kit, AEVD | Ma | ACT | | 100 assays | APT174 | $500 |
| Caspase 10 Colorimetric Assay Kit, AEVD | Ma | ACT | | 100 assays | APT176 | $475 |
| **Caspase 12** | | | | | | |
| Anti-Caspase 12, prodomain, aa100-116 mcaspase 12. | H M R | WB | Rb | 100 µg | AB3612 | $220 |
| Anti-Caspase 12, N-terminus | H M R | WB | Rb | 100 µg | AB3613 | $220 |
| **Caspase 13** | | | | | | |
| Anti-Caspase 13 | H M R | WB | Rb | 100 µg | AB16531 | $220 |
| **Caspase 14** | | | | | | |
| Anti-Caspase 14, clone 8-1-71 | H | WB | M $IgG_{1\kappa}$ | 100 µg | 05-687 | $319 |
| **Cathepsin** | | | | | | |
| Anti-Cathepsin B | M R | WB IH | Rb IgG | 400 µg | 06-480 | $319 |
| Anti-Cathepsin B | H | WB | Rb | 100 µg | AB4064 | $240 |
| Anti-Cathepsin D | H M | WB IC | Rb IgG | 200 µg | 06-467 | $319 |
| Anti-Cathepsin D, clone C5 | H | IH(P) | M $IgG_{2b}$ | 500 µL | MAB422 | $300 |
| IHC Select Anti-Cathepsin D, prediluted, clone C5 | H | IH(P) | M $IgG_{2b}$ | 6 mL | IHC2105-6 | $235 |
| IHC Select Anti-Cathepsin D, prediluted, clone C5 | H | IH(P) | M $IgG_{2b}$ | 6 mL | IHCR2105-6 | $235 |
| Anti-Cathepsin G, clone AHN-11 | H | RIA IC | M $IgG_{2a}$ | 100 µL | MAB1054 | $190 |
| Anti-Cathepsin K, clone 182-12G5 | H | WB Web* | M $IgG_{1\kappa}$ | 100 µg | MAB3324 | $265 |
| **CIDE** | | | | | | |
| Anti-CIDE-A, C-terminus | H | WB | Rb | 100 µg | AB16508 | $195 |
| Anti-CIDE-A, C-terminus | M | WB | Rb | 100 µg | AB16922 | $210 |
| Anti-CIDE-B, C-terminus | M | WB | Rb | 100 µg | AB16923 | $195 |
| **Cyclophilin A** | | | | | | |
| Anti-Cyclophilin A | H M R | WB | Rb IgG | 200 µL | 07-313 | $299 |
| Cyclophilin A (human) *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-004979 | $375 |
| Cyclophilin A (mouse) *SMART*pool siRNA reagent | M | RNAi | | 5 nmol | M-040767 | $375 |
| siRNA plasmid, pKD-Cyclophilin A-v1 | H | RNAi | | 5 µg | 62-079 | $349 |
| siRNA plasmid, pKD-Cyclophilin A-v2 | H | RNAi | | 5 µg | 62-080 | $349 |
| Cyclophilin A siRNA/siAb Starter Kit (human) | H | WB RNAi | | 1 kit | 61-003 | $649 |
| Cyclophilin A siRNA/siAb Starter Kit (mouse) | M | WB RNAi | | 1 kit | 61-004 | $649 |
| **Cystatin** | | | | | | |
| Anti-Cystatin A | H M | WB | Rb | 200 µg | AB4065 | $240 |
| Anti-Cystatin C | H M R | WB IH | Rb IgG | 250 µg | 06-458 | $319 |
| siRNA plasmid, pKD-Cystatin C-v3 | H | RNAi | | 20 µg | 62-010 | $349 |
| **Cytochrome C** | | | | | | |
| Anti-Cytochrome C | H | ELISA | Ch | 100 µg | AB3425 | $325 |
| Anti-Cytochrome C | H R Rb Ca | WB IC | Sh | 100 µg | AB3547 | $235 |
| Anti-Cytochrome C, clone C-7 | H Eq | WB IH | M IgG | 200 µL | 05-479 | $329 |
| Anti-Cytochrome C, clone 7H8.2C12 | H M R | WB | M $IgG_{2b}$ | 100 µg | MAB1800 | $330 |
| Anti-Cytochrome C, clone CTC04 | H B Eq Ca | FC | M $IgG_1$ | 50 µg | MAB4612 | $210 |
| Cytochrome C ELISA Kit | H | ELISA | | 1 plate | APT200 | $525 |
| Cytochrome C 6H2.B4 Monoclonal | H M R | IP IC EM | M | 100 µL | MAB3914 | $315 |
| Cytochrome C 7H8.2C12 Monoclonal | H M R | WB | M | 100 µL | MAB3916 | $315 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **DAPK** | | | | | | |
| Anti-DAPK | H | WB | Rb IgG | 200 µg | 06-859 | $329 |
| Anti-DAP Kinase 2 | H M R | WB | Rb | 100 µg | AB3606 | $220 |
| **Daxx** | | | | | | |
| Anti-Daxx | H M R Ht | WB IP IC | Rb IgG | 200 µL | 07-471 | $299 |
| Anti-Daxx, C-terminus | H | WB | Rb | 100 µg | AB16959 | $210 |
| **Death Receptor** | | | | | | |
| Anti-DR3, C-terminus extracellular domain | H M | WB | Rb | 100 µg | AB16952 | $220 |
| Anti-DR3, N-terminus | H M | WB | Rb | 100 µg | AB16953 | $205 |
| Anti-DR3, clone B65 | H | IP IF FC | M $IgG_{2a}$ | 50 µg | MAB4614 | $210 |
| Anti-DR4, C-terminus | H | WB | Rb | 100 µg | AB16955 | $220 |
| Anti-DR4/TRAIL-R1 | H M R | WB | Rb IgG | 200 µg | 06-744 | $299 |
| Anti-DR5, C-terminus | H | WB | Rb | 100 µg | AB16942 | $220 |
| **Decoy Receptor** | | | | | | |
| Anti-DcR1, extracellular | H | WB | Rb | 100 µg | AB16509 | $220 |
| Anti-DcR2, intracellular domain | H | WB | Rb | 100 µg | AB16943 | $220 |
| Anti-DcR3, N-terminus | H M R | WB | Rb | 100 µg | AB16510 | $195 |
| **DEDAF** | | | | | | |
| Anti-DEDAF | H M R | WB | Rb | 100 µg | AB3637 | $220 |
| **DFF** | | | | | | |
| Anti-ICAD/DFF, N-terminus (a.a. 2-21 of mouse ICAD) | M | WB | Rb | 100 µg | AB16965 | $220 |
| Anti-DFF40 | H M R | WB | Rb | 100 µg | AB16926 | $210 |
| Anti-DFF45/35, N-terminus | H | WB IP | Rb | 100 µg | AB16961 | $205 |
| Anti-DFF45, C-terminus | H | WB IP | Rb | 100 µg | AB16962 | $205 |
| **Single Stranded DNA** | | | | | | |
| Anti-DNA, single stranded specific, clone F7-26 | A | FC IC IH IH(P) | M IgM | 50 µg | MAB3299 | $210 |
| Anti-DNA, single stranded | A | ELISA FC IC IH(P) | M $IgG_{2a}$ | 100 µg | MAB3868 | $265 |
| Anti-DNA, single stranded, clone 16-19 | A | ELISA | M $IgG_{2a}$ | 500 µL | MAB3034 | $190 |
| ssDNA Apoptosis ELISA Kit | Ma | ELISA | | 1 plate | APT225 | $325 |
| **DOK** | | | | | | |
| Anti-DOK, C-terminus | H | WB | Rb | 100 µg | AB16948 | $205 |
| **DRAK** | | | | | | |
| Anti-DRAK1, N-terminus | H M R | WB | Rb | 100 µg | AB16514 | $205 |
| Anti-DRAK2, C-terminus | H | WB | Rb | 100 µg | AB16515 | $205 |
| **Endonuclease G** | | | | | | |
| Anti-Endonuclease G | H M R | WB | Rb | 100 µg | AB3639 | $195 |
| **FADD** | | | | | | |
| Anti-FADD | H | WB IP | Rb IgG | 200 µg | 06-711 | $289 |
| Anti-FADD | H M R Mk | WB IP | Rb | 50 µg | AB3102 | $210 |
| Anti-FADD, clone 1F7 | H M | WB | M $IgG_1$ | 100 µg | 05-486 | $319 |
| **FAS and FAS Ligand** | | | | | | |
| **FAS** | | | | | | |
| Anti-Fas (human, activating), clone CH11 | H | WB FC IC | M IgM | 50 µg | 05-201 | $339 |
| Anti-Fas (human, neutralizing), clone ZB4 | H | NEUT | M $IgG_1$ | 100 µg | 05-338 | $329 |
| Anti-Fas, clone 7C10 | M B | WB IP | R $IgG_{2a}$ | 200 µg | 05-351 | $299 |
| Anti-Fas, clone B-G27 | H R | FC IH | M $IgG_{2a}$ | 100 assays | CBL527B | $240 |
| Anti-Fas, clone B-G27 | H R | FC IH | M $IgG_{2a}$ | 100 assays | CBL527F | $240 |
| Anti-Fas, clone B-D29 | H | IP FC | M $IgG_1$ | 100 µg | CBL537 | $130 |
| Anti-Fas, clone SM1/1 | H | C IND | M $IgG_{2a}$ | 100 µg | MAB3061 | $210 |
| Anti-Fas, clone SM1/23 | H | FC INHIB | M $IgG_{2a}$ | 100 µg | MAB3065 | $220 |
| Anti-Fas, clone 95C02 | H | IF | M IgG | 150 µg | MAB4621 | $200 |
| Anti-Fas, clone 95C03 | H | IH | M $IgG_1$ | 250 µL | MAB4622 | $210 |
| Soluble Fas ELISA Kit | | ELISA | | 1 plate | APT177 | $575 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **FAS Ligand** | | | | | | |
| Anti-Fas Ligand | H M R | WB ELISA | Rb | 100 µL | AB1665 | $390 |
| Anti-Fas Ligand | H M R | WB ELISA | Rb | 50 µg | AB16982 | $290 |
| Anti-Fas Ligand, clone ALF1.2 | H | ELISA FC | M | 100 µL | MAB3912 | $315 |
| Anti-CD95L, clone MFL3 | M | IF FC | AHt IgG | 500 µg | CBL1369 | $415 |
| Anti-CD95L, clone MFL3 | M | IF FC | AHt IgG | 500 µg | CBL1369B | $430 |
| Anti-CD95L, clone MFL3 | M | FC | AHt IgG | 100 µg | CBL1369P | $295 |
| Anti-CD178, clone B-R17 | H | FC INHIB NEUT | M $IgG_1$ | 100 µg | CBL587 | $135 |
| Anti-Fas Ligand, clone FSL01 | H | WB | M IgM | 250 µL | MAB4623 | $210 |
| Fas Ligand, membrane bound | | CC | | 500 ng | 01-210 | $309 |
| **FLASH** | | | | | | |
| Anti-FLASH | H | WB | Rb | 100 µg | AB3605 | $205 |
| **FLIP** | | | | | | |
| Anti-FLIP, NT | H M | WB | Rb IgG | 200 µg | 06-697 | $319 |
| Anti-FLIP, CT | H M R | WB | Rb IgG | 200 µg | 06-864 | $319 |
| Anti-FLIP, N-terminus | H M R | WB | Rb | 100 µg | AB16516 | $220 |
| Anti-FLIP, C-terminus | H | WB | Rb | 100 µg | AB16963 | $220 |
| Anti-FLIPγ/δ, C-terminus | H M | WB | Rb | 100 µg | AB16998 | $205 |
| Anti-mFLIP, C-terminus | M | WB IP | Rb | 100 µg | AB16964 | $195 |
| **Fractin** | | | | | | |
| Anti-Fractin, C-terminus | H M R | WB IC IH(P) | Rb | 100 µL | AB3150 | $265 |
| **Glutathione** | | | | | | |
| Glutathione Detection Kit | Ma | ACT | | 100 assays | APT250 | $325 |
| **Granzyme B** | | | | | | |
| Anti-Granzyme B, clone GrB-7 | H | WB IH(P) | M $IgG_{2a}$ | 250 µL | MAB3070 | $190 |
| Anti-Granzyme B, clone 2C5/F5 | H R | WB ELISA FC IC | M $IgG_{2a}$ | 100 µg | MAB3170 | $290 |
| **GSK-3** | | | | | | |
| Anti-GSK-3 | H M R Mk Ch | WB IHC | Rb | 500 µL | AB9258 | $300 |
| Anti-phospho-GSK-3β (Ser9) | H R | WB | Rb IgG | 100 µL | 07-835 | $309 |
| Anti-GSK-3β | H M R B | WB IP ICC | Rb | 50 µg | AB8687 | $180 |
| Anti-GSK-3α | H | ELISA Web* | Chk | 100 µg | AB3441 | $330 |
| Anti-GSK-3β | H | ELISA Web* | Chk | 100 µg | AB3443 | $330 |
| Anti-GSK-3α | H R | WB IPK | Rb IgG | 200 µg | 07-389 | $309 |
| Anti-phospho-GSK3β (Ser9), clone 2D3 | H M R | WB EMSA | M $IgG_{1κ}$ | 100 µg | 05-643 | $329 |
| Anti-phospho-GSK3α (Ser21), clone BK202 | H R | WB | M $IgG_{1κ}$ | 100 µg | 05-676 | $319 |
| Anti-GSK3α, clone AW103 | H M R | WB IPK | Rb IgG | 100 µg | 05-737 | $319 |
| Anti-phospho-GSK3α (Ser21) | H | WB | Rb IgG | 100 µL | 07-393 | $319 |
| Anti-phospho-GSK3α (Ser21) | H R | WB | Sh IgG | 200 µg | 07-420 | $309 |
| **Histone H2A.X** | | | | | | |
| Anti-phospho-H2A.X (Ser139) | WR | WB IP | Rb IgG | 200 µg | 07-164 | $319 |
| Anti-phospho-Histone H2A.X (Ser139), clone JBW301 | WR | WB IF IC | M $IgG_1$ | 200 µg | 05-636 | $349 |
| Anti-phospho-Histone H2A.X (Ser139), clone JBW301, biotin conjugate | WR | WB IC | M $IgG_1$ | 100 µg | 16-193 | $359 |
| Anti-phospho-Histone H2A.X (Ser139), FITC conjugate | WR | FC | M $IgG_1$ | 100 µg | 16-202A | $319 |
| H2A.X Phosphorylation Assay Kit (Chemiluminescence Detection) | | ELISA | | 1 kit | 17-327 | $509 |
| H2A.X Phosphorylation Assay Kit (Flow Cytometry) | | FC | | 1 kit | 17-344 | $429 |
| **Histone H2B** | | | | | | |
| Anti-phospho-Histone H2B (Ser14), clone MC603 | H | BD FC | Rb IgG | 100 µg | 05-751 | $329 |
| Anti-phospho-Histone H2B (Ser14) | H | WB ELISA IC IH | Rb IgG | 200 µL | 07-191 | $319 |
| **HtrA2/Omi** | | | | | | |
| Anti-HtrA2/Omi, clone 18-1-83 | H | WB | M IgG | 200 µL | 05-721 | $299 |
| **IκB** | | | | | | |
| New Anti-phospho-IκBα (Ser32/Ser36) | H | WB | Rb IgG | 100 µL | 07-836 | $309 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **IKK** | | | | | | |
| Anti-IKK2 | H M R B | WB | Ch | 100 µg | AB3451 | $330 |
| Anti-phospho-IKKα (Ser176/Ser180) | H | WB | Rb IgG | 100 µL | 07-837 | $309 |
| Anti-IKKα, clone 14A231 | H M Mk | WB | M $IgG_1$ | 100 µg | 05-536 | $329 |
| IKKα *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003473 | $375 |
| siRNA plasmid, pKD-IKKα-v3 | H M | RNAi | | 5 µg | 62-040 | $349 |
| siRNA plasmid, pKD-IKKα-v4 | H M R | RNAi | | 5 µg | 62-049 | $349 |
| Anti-IKKβ | H | WB | Rb | 100 µg | AB16522 | $205 |
| Anti-IKKβ, clone 10AG2 | H M R | WB | M $IgG_1$ | 100 µg | 05-535 | $329 |
| siRNA plasmid, pKD-IKKβ-v3 | H R | RNAi | | 5 µg | 62-039 | $349 |
| siRNA plasmid, pKD-IKKβ-v2 | H | RNAi | | 5 µg | 62-050 | $349 |
| IKK-β *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003503 | $375 |
| Anti-IKKγ, N-terminus | H | WB ELISA | Rb | 100 µg | AB3458 | $220 |
| Anti-IKKγ | H M | WB | M IgG | 100 µg | 05-631 | $329 |
| siRNA plasmid, pKD-IKKγ-v2 | H | RNAi | | 5 µg | 62-053 | $349 |
| IKKγ *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003767 | $375 |
| Anti-IKKε | H | WB | Rb IgG | 200 µg | 07-580 | $319 |
| siRNA plasmid, pKD-IKKε-v2 | H | RNAi | | 5 µg | 62-031 | $349 |
| siRNA plasmid, pKD-IKKε-v3 | H | RNAi | | 5 µg | 62-051 | $349 |
| **ILP-2** | | | | | | |
| Anti-ILP-2 | H M R | WB | Rb | 50 µL | AB4514 | $195 |
| **IAP (Inhibitor of Apoptosis)** | | | | | | |
| Anti-cIAP-1 | H M R | WB | Rb | 50 µg | AB3614 | $240 |
| Anti-HIAP-2 (cIAP-1) | H M R | WB | Rb IgG | 200 µg | 07-759 | $289 |
| Anti-cIAP-2 | H M R | WB | Rb | 50 µg | AB3615 | $240 |
| Anti-NAIP | H | WB | Rb | 50 µg | AB3617 | $240 |
| Anti-XIAP | H | WB | Rb | 50 µg | AB3616 | $240 |
| Anti-RIAP-3 (XIAP) | H R | WB | Rb IgG | 200 µg | 07-753 | $289 |
| **JNK** | | | | | | |
| Anti-JNK/SAPK1 | H M R | WB IP | Rb IgG | 200 µg | 06-748 | $309 |
| Anti-JNK1 | M R | IP KA | Sh | 250 µg | AB4081 | $240 |
| Anti-phospho-JNK (Thr183/Tyr185, Thr221/Tyr223) | H M R | WB IP | Rb IgG | 200 µg | 07-175 | $319 |
| Anti-JNK2 | H M R | WB IP ELISA | Rb | 50 µL | AB8910 | $189 |
| siRNA plasmid, pKD-JNK2α2/SAPK1a-v1 | H | RNAi | | 5 µg | 62-097 | $349 |
| siRNA plasmid, pKD-JNK2α2/SAPK1a-v5 | H M | RNAi | | 5 µg | 62-098 | $349 |
| JNK2 *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003515 | $375 |
| JNK2/SAPK1a siRNA/siAb Assay Kit | H | WB RNAi | | 1 kit | 60-099 | $649 |
| Anti-JNK3/SAPK1b, clone C05T | H R | WB | Rb IgG | 100 µL | 05-893 | $319 |
| **Livin** | | | | | | |
| Anti-Livin | H | WB | Rb | 100 µg | AB3632 | $280 |
| **Mcl-1** | | | | | | |
| Anti-Mcl-1 | H | WB IP IH(P) | Rb | 100 µL | AB2910 | $240 |
| Anti-Mcl-1, clone RC13 | H | WB IP IH(P) | M $IgG_1$ | 100 µg | MAB4602 | $280 |
| Anti-Mcl-1, clone RC31 | H | WB IP | M $IgG_1$ | 50 µg | MAB4624 | $185 |
| **MKK** | | | | | | |
| Anti-MKK7/SKK4 | H | WB | Rb IgG | 100 µg | 07-399 | $319 |
| Anti-phospho-MKK7/SKK4 (Thr275/Ser277) | H | WB | Rb IgG | 100 µL | 36-010 | $319 |
| Anti-phospho-MKK7/SKK4 (Thr275) | H | WB | Rb IgG | 200 µg | 36-013 | $319 |
| **mTOR** | | | | | | |
| Anti-mTOR (mTAb1) | H M R | WB IPK KA | Rb | 200 µL | 07-231 | $299 |
| Anti-mTOR | H R | WB IP | Rb | 100 µg | AB3882 | $235 |
| **p35** | | | | | | |
| Anti-p35 (cdk5 regulator) | H B | IP | M IgG | 100 µg | 05-380 | $329 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **p38/MAPK/SAPK** | | | | | | |
| New Anti-p38α | H M R | WB IP IPK ELISA | Rb IgG | 100 µg | 09-273 | $309 |
| New Anti-p38 MAPK, phospho-specific (Thr180/Tyr182) | H M R | WB IP IPK IF | Rb IgG | 100 µL | 09-272 | $319 |
| GST-p38α, recombinant human inactive | | | | 25 µg | SGT221 | $290 |
| p38α MAPK, recombinant human active | | | | 10 µg | SGT222 | $330 |
| Non-radioactive p38 Kinase Assay Kit | | | | 40 assays | SGT455 | $345 |
| Anti-p38/SAPK2, clone 2F11 | H M R | WB IP | M IgG | 200 µg | 05-454 | $329 |
| p38α/SAPK2a Assay Kit, 50 Assays | | KA | | 1 kit | 17-169 | $560 |
| p38/SAPK2 *SMART*pool siRNA reagent | | RNAi | | 5 nmol | M-003512 | $375 |
| p38/SAPK2 siRNA/siAb™ Assay Kit | H | WB RNAi | | 1 kit | 60-032 | $649 |
| Anti-p38γ/SAPK3 | M R | WB | Rb IgG | 200 µg | 07-139 | $309 |
| Anti-p38γ/SAPK3 | H | WB | Rb IgG | 200 µg | 07-474 | $319 |
| Anti-p38γ/SAPK3 | H | WB | Rb IgG | 200 µL | 07-508 | $309 |
| Anti-p38δ/SAPK4 | H R | WB | Rb IgG | 200 µg | 07-603 | $309 |
| **PARP** | | | | | | |
| Anti-PARP Poly ADP-ribose Polymerase-1 | H M R B | WB ELISA | Rb | 100 µL | AB16661 | $330 |
| Anti-PARP Cleaved Form | H | WB | Rb | 50 µg | AB3620 | $240 |
| Anti-Poly ADP-ribose, clone 10H | A | WB IP IC | M $IgG_{3a}$ | 50 µL | MAB3192 | $265 |
| Anti-PARP, clone A6.4.12 | H M R Ht Xn Dr | WB IP ELISA IH IH(P) | M $IgG_1$ | 2 mL | MAB3217 | $380 |
| Anti-PARP, clone C-2-10 | H M R Ht Av | WB ELISA IC | M $IgG_1$ | 50 µg | MAB3290 | $300 |
| Anti-VPARP, clone p193-4 | H | WB IH | M $IgG_1$ | 100 µg | MAB4142 | $260 |
| Anti-phospho-PARP | H M | WB IC | Rb | 100 µL | AB3565 | $315 |
| siRNA plasmid, pKD-PARP-v2 | H | RNAi | | 5 µg | 62-156 | $349 |
| **PDK** | | | | | | |
| Anti-PDK1 | H R | WB IPK | Rb IgG | 100 µL | 07-707 | $309 |
| Anti-PDK1 | H R | WB IPK | Rb IgG | 100 µL | 07-707 | $309 |
| Anti-Pyruvate Dehydrogenase Kinase isoform 1 | H | WB | Rb | 100 µg | AB4236 | $235 |
| Anti-Pyruvate Dehydrogenase Kinase isoform 2 | H | WB | Rb | 100 µg | AB4238 | $235 |
| PDK1 Immunoprecipitation Kinase Assay Kit | | IPK | | 1 kit | 17-279 | $459 |
| PDK1 Immunoprecipitation Kinase Assay Kit | | IPK | | 1 kit | 17-279 | $459 |
| PDK1 Kinase Assay Kit | | KA | | 1 kit | 17-280 | $459 |
| PDK1 Kinase Assay Kit | | KA | | 1 kit | 17-280 | $459 |
| **Perforin** | | | | | | |
| Anti-Perforin, clone dG9 | H M | IP IF FC IH | M $IgG_{2b\kappa}$ | 50 µg | MAB4616 | $210 |
| **PHAP** | | | | | | |
| Anti-PHAP, N-terminus | H M R | WB | Rb | 50 µL | AB4515 | $195 |
| **Phosphatidylserine** | | | | | | |
| Anti-Phosphatidylserine, clone 1H6 | WR | FC IH | M IgG | 200 µg | 05-719 | $339 |
| Anti-Phosphatidylserine, clone 1H6, Alexa Fluor 488 conjugate | WR | FC | M IgG | 100 µg | 16-256 | $339 |
| **PI 3-Kinase** | | | | | | |
| Anti-PI 3-Kinase, p85 | H M R Mk | WB IP | Rb IgG | 125 µL | 06-195 | $329 |
| Anti-PI 3-Kinase, p85, N-SH2 domain | H M R Mk | WB IP | Rb IgG | 250 µg | 06-496 | $329 |
| Anti-PI 3-Kinase, p85 | H M R Mk | WB IP | Rb IgG | 250 µg | 06-497 | $319 |
| Anti-PI 3-Kinase, p85, N-SH3, clone AB6 | H M | WB IP IC | M $IgG_{1\kappa}$ | 100 µg | 05-212 | $339 |
| Anti-PI 3-Kinase, p85, N-SH2, clone UB93-3 | H M R | WB IP | M IgG | 200 µL | 05-217 | $329 |
| Anti-PI 3-Kinase p85α, clone 8-2D-4D | H M R | IP IF FC | M $IgG_1$ | 100 µg | MAB1143 | $265 |
| PI 3-Kinase p85α *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003020 | $375 |
| siRNA plasmid, pKD-PI3 Kinase, p85-v3 | | RNAi | | 5 µg | 62-222 | $349 |
| Anti-PI3 Kinase, p101 | H R | WB | Rb $IgG_1$ | 200 µg | 07-281 | $309 |
| Anti-PI3 Kinase, p110α | H WR | IP | Rb IgG | 200 µg | 07-658 | $309 |
| Anti-PI3 Kinase, p110β | H M R B | IP | Rb IgG | 200 µg | 06-568 | $329 |
| Anti-PI3 Kinase, p110δ, clone AW103 | H | WB | M $IgG_{1\kappa}$ | 200 µg | 05-703 | $329 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **PKA** | | | | | | |
| Anti-PKA, NT | H M R Ht B Po | WB | Rb IgG | 200 µg | 06-903 | $319 |
| Anti-PKA, RII subunits | H R | WB IP IC | Gt IgG | 500 µg | 06-411 | $329 |
| Anti-phospho-PKA, RII (Ser96) | M R | WB | Rb IgG | 100 µg | 06-704 | $309 |
| Anti-phospho-PKA, Regulatory subunit IIβ (Ser114) | M | WB | Rb IgG | 100 µL | 07-869 | $309 |
| Anti-phospho-PKA catalytic subunits α/β (Thr197) | M | WB | Rb IgG | 100 µL | 07-867 | $309 |
| Anti-phospho-PKA Catalytic β subunit (Ser338) | M | WB | Rb IgG | 100 µL | 07-868 | $309 |
| PKA Assay Kit | | KA | | 1 kit | 17-134 | $229 |
| PKA Inhibitor Cocktail | | KA | | 1 mL | 20-114 | $94 |
| PKA/PKC Inhibitor Cocktail | | KA | | 1 mL | 20-129 | $94 |
| PKA/CaMK Inhibitor Cocktail | | KA | | 1 mL | 20-132 | $94 |
| siRNA plasmid, pKD-PKAα-v2 | H | RNAi | | 5 µg | 62-069 | $349 |
| PKA siRNA/siAb Assay Kit | H | WB RNAi | | 1 kit | 60-115 | $649 |
| Anti-cAMP-Dependent Protein Kinase, Regulatory Subunit I-β, internal | H M Mk | WB IH | Rb | 100 µg | AB1612 | $235 |
| Anti-cAMP-Dependent Protein Kinase, Regulatory Subunit II-α | H M Mk | WB IP ELISA FC IH | Rb | 100 µg | AB1613 | $235 |
| Anti-cAMP-Dependent Protein Kinase, Regulatory Subunit II-β, internal | H M Mk | WB IH | Rb | 100 µg | AB1614 | $235 |
| **PKC** | | | | | | |
| **PKCα** | | | | | | |
| Anti-PKCα, β, γ | H M R Rb B | WB | Rb IgG | 200 µg | 06-870 | $309 |
| Anti-PKCα, clone M4 | H M R Rb B | WB IP NEUT | M $IgG_1$ | 100 µg | 05-154 | $329 |
| Anti-Protein Kinase Cα, clone 1F3.2 | H | WB ELISA | M IgM | 100 µL | MAB3074 | $180 |
| Anti-phospho-PKCα (Thr638) | H M | WB | Rb IgG | 100 µL | 07-871 | $309 |
| Anti-phospho-PKCα (Ser657) | H M R Rb B | WB | Rb IgG | 200 µg | 06-822 | $319 |
| PKCα *SMART*pool siRNA reagent | | RNAi | | 5 nmol | M-003523 | $375 |
| siRNA plasmid, pKD-PKCα-v4 | H | RNAi | | 5 µg | 62-104 | $349 |
| siRNA plasmid, pKD-PKCα-v6 | H M | RNAi | | 5 µg | 62-105 | $349 |
| **PKCβ** | | | | | | |
| Anti-phospho-PKCβ I&II (Thr500) | H | WB | Rb IgG | 100 µL | 07-870 | $309 |
| Anti-phospho-PKCβ I (Thr642) | H | WB | Rb IgG | 100 µL | 07-872 | $309 |
| Anti-phospho-PKCβ II (Thr641) | H | WB | Rb IgG | 100 µL | 07-873 | $309 |
| **PKCδ** | | | | | | |
| Anti-PKCδ | H M R | WB | Rb IgG | 200 µg | 06-990 | $309 |
| Anti-PKCδ | H M | WB IP IH | Sh | 100 µg | AB1685 | $180 |
| Anti-phospho-PKCδ (Ser645) | H | WB | Rb IgG | 100 µL | 07-874 | $309 |
| Anti-phospho-PKCδ (Ser664) | H | WB | Rb IgG | 100 µL | 07-875 | $309 |
| siRNA plasmid, pKD-PKCδ-v3 | H | RNAi | | 5 µg | 62-071 | $349 |
| siRNA plasmid, pKD-PKCδ-v6 | H M R | RNAi | | 5 µg | 62-072 | $349 |
| **PKCε** | | | | | | |
| Anti-PKCε | H M R | WB IP IH | Rb IgG | 200 µg | 06-991 | $309 |
| Anti-phospho-PKCε (Ser729) | H M R Rb | WB | Rb IgG | 200 µg | 06-821 | $329 |
| siRNA plasmid, pKD-PKCε-v1 | H | RNAi | | 5 µg | 62-121 | $349 |
| siRNA plasmid, pKD-PKCε-v5 | H | RNAi | | 5 µg | 62-122 | $349 |
| PKCε *SMART*pool siRNA reagent | | RNAi | | 5 nmol | M-004653 | $375 |
| **PKCθ** | | | | | | |
| Anti-phospho-PKCθ (Ser676) | H | WB | Rb IgG | 100 µL | 07-883 | $309 |
| Anti-phospho-PKCθ (Ser695) | H | WB | Rb IgG | 100 µL | 07-884 | $309 |
| Anti-phospho-PKCθ (Thr538) | H | WB | Rb IgG | 100 µL | 07-885 | $309 |
| **PKCη** | | | | | | |
| Anti-phospho-PKCη (Thr655) | H | WB | Rb IgG | 100 µL | 07-877 | $309 |
| Anti-phospho-PKCη (Ser674) | H | WB | Rb IgG | 100 µL | 07-876 | $309 |

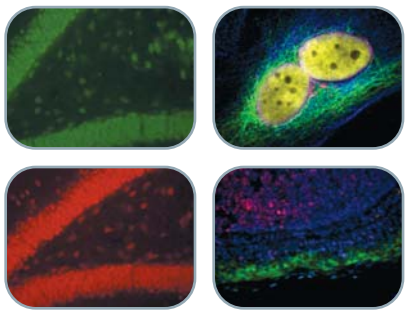
| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| **PKCζ** | | | | | | |
| Anti-PKCζ | H M R | WB | Rb IgG | 200 µL | 07-264 | $309 |
| siRNA plasmid, pKD-PKCζ-v1 | H | RNAi | | 5 µg | 62-073 | $349 |
| siRNA plasmid, pKD-PKCζ-v3 | H | RNAi | | 5 µg | 62-074 | $349 |
| PKCζ *SMART*pool siRNA reagent | | RNAi | | 5 nmol | M-003526 | $375 |
| **PKC General Reagents** | | | | | | |
| PKC Assay Kit | | KA | | 1 kit | 17-139 | $229 |
| PKC Lipid Activator | | KA | | 1 ml | 20-133 | $74 |
| PKC/CaMK Inhibitor Cocktail | | KA | | 1 ml | 20-119 | $94 |
| PKC Substrate Cocktail | | KA | | 1 ml | 20-131 | $135 |
| **PP2A** | | | | | | |
| Anti-Protein Phosphatase 2 A/C | H M R B Ch | WB | Rb | 100 µL | AB1621 | $265 |
| P2A Immunoprecipitation Phosphatase Assay Kit | | PA | | 25 assays | 17-313 | $379 |
| Anti-PP2A, A subunit | H M R Po Xn | WB IP | Rb IgG | 100 µg | 07-250 | $309 |
| Anti-PTPA, clone 5G3 | H M | WB | M | 100 µL | 05-941 | $279 |
| Anti-PP2A, A subunit, clone 4G7 | H M R Xn | WB | M $IgG_1$ | 200 µg | 05-657 | $329 |
| PP2A Cα subunit *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003598 | $375 |
| Anti-PP2A, B' subunit | H M Rb | WB | Rb IgG | 200 µg | 07-334 | $309 |
| Anti-PP2A, B' subunit, clone 2G9 | H M R Rb B | WB IP IH Po Xn | M IgG | 200 µL | 05-592 | $319 |
| Anti-PP2A, C subunit | H M R Rb | WB IP | Rb IgG | 200 µg | 06-222 | $309 |
| Anti-PP2A, C subunit | H M R B | WB | Rb IgG | 100 µL | 07-324 | $309 |
| Anti-Protein Phosphatase 2 C α/β | H M R B | WB | Rb | 100 µg | AB4090 | $240 |
| Anti-PP2A, C subunit, clone 1D6 | H M R Rb B Xn Y | WB IP IC | M $IgG_{2b\kappa}$ | 200 µg | 05-421 | $329 |
| Anti-PP2A, C subunit, clone 7A6 | H M Y | WB IP | M IgG | 200 µL | 05-545 | $329 |
| Anti-methyl-PP2A, C subunit, clone 2A10 | H M R Rb Po Ch Dr Y | WB | M IgG | 2 mL | 05-546 | $329 |
| Anti-phospho-PP2A, C subunit (Tyr307), clone 4B10 | WR | ELISA | M $IgG_1$ | 100 µL | 05-547 | $329 |
| Anti-PP2A, C subunit, demethylated, clone 4B7 | WR | WB IP IC | M IgG | 200 µL | 05-577 | $329 |
| **PP2A-methylesterase** | | | | | | |
| Anti-PP2A-methylesterase/PME-1 | H M R | WB IP | Rb IgG | 200 µg | 07-095 | $309 |
| Anti-PP2A-methyltransferase/PPMT1, clone 4A4 | M R | WB | M $IgG_1$ | 100 µg | 05-849 | $319 |
| **PTEN** | | | | | | |
| Anti-PTEN, C-terminus, clone A2b1 | H M R | WB IP IC IH IH(P) | M $IgG_1$ | 100 µg | MAB4037 | $245 |
| Anti-phospho-PTEN (Ser370) | M | WB | Rb IgG | 100 µL | 07-889 | $309 |
| Anti-phospho-PTEN (Ser385) | H | WB | Rb IgG | 100 µL | 07-890 | $309 |
| Anti-phospho-PTEN (Ser380/Thr382/Thr383/Ser385) | H M | WB | Rb IgG | 100 µL | 07-891 | $309 |
| PTEN Malachite Green Assay Kit | | PA | | 1 kit | 17-351 | $429 |
| PTEN Enzyme Assay Buffer, 5X | | PA | | 1 ml | 20-165 | $54 |
| PTEN *SMART*pool siRNA reagent | H | RNAi | | 5 nmol | M-003023 | $375 |
| **PUMA** | | | | | | |
| Anti-PUMA | H | WB | Rb IgG | 100 µL | 07-669 | $309 |
| Anti-PUMA, C-terminus | H M | WB | Rb | 50 µL | AB4510 | $195 |
| **Raf** | | | | | | |
| Anti-Raf-1 | H | WB IPK | Rb IgG | 200 µg | 07-396 | $319 |
| Anti-B-Raf | H M R | WB IPK | Rb IgG | 200 µg | 07-453 | $319 |
| Anti-B-Raf, NT | H M R | WB KA | Rb IgG | 200 µL | 07-583 | $319 |
| Anti-C-raf-1, a.a. 38-53 | H | WB ELISA | Sh | 100 µg | CBL445 | $235 |
| Anti-Raf-1, clone AM223 | | WB IP | Rb IgG | 100 µg | 05-739 | $319 |
| Anti-phospho-Raf-1 (Ser338) | M | WB | R $IgG_1$ | 100 µg | 05-534 | $329 |
| Anti-phospho-Raf-1 (Ser338) | M | WB | M IgG | 200 µg | 05-538 | $329 |
| Anti-phospho-Raf1 (Ser259) | H | WB | Rb IgG | 100 µL | 07-811 | $309 |
| Anti-phospho-Raf1 (Ser43) | H | WB | Rb IgG | 100 µL | 07-812 | $309 |
| Anti-phospho-Raf-1 (Ser621) | H | WB | Rb IgG | 100 µL | 07-813 | $309 |
| Raf-1-RBD GST Protein, Ras binding domain | | | | 300 µg | SGT223 | $325 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| Raf-1 Kinase Cascade Assay Kit | | IPK KA | | 1 kit | 17-357 | $474 |
| B-Raf Kinase Cascade Assay Kit | | IPK KA | | 1 kit | 17-358 | $474 |
| B-Raf Kinase Assay Kit, Chemiluminescence Detection | | WB KA | | 1 kit | 17-359 | $474 |
| Raf-1 Kinase Assay Kit, Chemiluminescence Detection | | KA | | 1 kit | 17-360 | $474 |
| Raf-1 *SMART*pool siRNA reagent | | RNAi | | 5 nmol | M-003601 | $375 |
| siRNA plasmid, pKD-Raf-1-v4 | H M R | RNAi | | 5 µg | 62-085 | $349 |
| siRNA plasmid, pKD-Raf-1-v6 | H | RNAi | | 5 µg | 62-086 | $349 |
| Raf-1 siRNA/siAb Assay Kit | H | WB RNAi | | 1 kit | 60-109 | $649 |
| Raf-1 cDNA (wt) in pUSEamp | | TFX | | 5 µg | 21-111 | $599 |
| **RAIDD** | | | | | | |
| Anti-RAIDD, C-terminus | H | WB | Rb | 100 µg | AB16958 | $205 |
| siRNA plasmid, pKD-RAIDD/CRADD-v1 | H | RNAi | | 5 µg | 62-157 | $349 |
| siRNA plasmid, pKD-RAIDD/CRADD-v2 | H | RNAi | | 5 µg | 62-158 | $349 |
| **RICK** | | | | | | |
| Anti-RICK, N-terminus | H | WB | Rb | 100 µg | AB17004 | $220 |
| **ROCK** | | | | | | |
| Anti-ROCK-1 | H M | WB | Rb | 100 µg | AB3885 | $240 |
| siRNA plasmid, pKD-ROK$\beta$/ROCK-I-v4 | | RNAi | | 5 µg | 62-228 | $349 |
| Anti-ROK$\alpha$/ROCK-II | R | WB IP | Rb IgG | 200 µg | 07-443 | $319 |
| Anti-ROK$\alpha$/ROCK-II, clone A9W4 | H R | WB IP | Rb IgG | 100 µL | 05-841 | $309 |
| siRNA plasmid, pKD-ROK$\alpha$/ROCK-II-v4 | H M R | RNAi | | 5 µg | 62-075 | $349 |
| siRNA plasmid, pKD-ROK$\alpha$/ROCK-II-v6 | H M R | RNAi | | 5 µg | 62-076 | $349 |
| **p70 S6 Kinase** | | | | | | |
| Anti-S6 Kinase | H M R B Po | WB IP ELISA | Rb | 100 µg | AB3191 | $195 |
| Anti-p70 S6 Kinase | H M R | WB | Rb IgG | 200 µg | 06-926 | $309 |
| Anti-p70 S6 Kinase | H M R | WB IP IPK | Rb IgG | 200 µg | 07-402 | $329 |
| Anti-S6 Kinase II | H Mk | WB | Sh IgG | 100 µg | 07-173 | $299 |
| Anti-p70 S6 Kinase, clone SB20 | H M R | WB | Rb IgG | 100 µL | 05-781 | $319 |
| Anti-phospho-Ribosomal Protein S6 (Ser235), clone MC27 | H M R | WB | Rb IgG | 100 µL | 05-795 | $329 |
| Anti-phospho-p70 S6 Kinase (Thr412) | H M | WB | Rb IgG | 100 µg | 07-018 | $309 |
| Anti-phospho-Ribosomal Protein S6 (Ser235) | M R Ch Xn | WB | Rb IgG | 200 µg | 07-433 | $329 |
| p70 S6 Kinase Assay Kit | | KA | | 1 kit | 17-136 | $229 |
| Kemptide, 1mM | | KA | | 500 µL | 20-199 | $159 |
| siRNA plasmid, pKD-p70 S6 Kinase II-v2 | H | RNAi | | 5 µg | 62-101 | $349 |
| siRNA plasmid, pKD-p70 S6 Kinase II-v4 | H | RNAi | | 5 µg | 62-102 | $349 |
| S6 Kinase Substrate Cocktail | | KA | | 1 mL | 20-122 | $135 |
| **Smac/Diablo** | | | | | | |
| Anti-Smac/Diablo | H M R | WB | Rb | 100 µg | AB3609 | $220 |
| Anti-Smac/Diablo, clone 17-1-87 | H | IP | M $IgG_{1\kappa}$ | 100 µg | 05-674 | $319 |
| Anti-Smac/Diablo, clone 78-1-118 | H | WB | M $IgG_1$ | 100 µg | MAB4626 | $265 |
| Anti-Smac/Diablo, clone 78-1-118 | H | WB | M IgG | 200 µg | 05-681 | $319 |
| **SODD** | | | | | | |
| Anti-SODD, N-terminus | H M R | WB | Rb | 100 µg | AB16518 | $220 |
| **TRAD** | | | | | | |
| Anti-TRADD, clone 3E11 | H | WB IP | M $IgG_{2a\kappa}$ | 100 µg | 05-473 | $309 |
| **TRAIL** | | | | | | |
| Anti-TRAIL, C-terminus | H | WB | Rb | 100 µg | AB16957 | $220 |
| TRAIL, recombinant human | | | | 50 µg | GF092 | $220 |
| **Transglutaminase** | | | | | | |
| Anti-Transglutaminase type II | M Gp | WB IP | Gt antiserum | 250 µL | 06-471 | $319 |
| Anti-Tissue Transglutaminase, FN binding domain, clone 4G3 | H IC | M | | 100 µg | MAB3839 | $295 |

| Description | Species | Applications | Host | Quantity | Cat. No. | Price |
|---|---|---|---|---|---|---|
| Other Apoptosis Reagents | | | | | | |
| Apoptosis Inducer Set | | | | 1 kit | APT800 | $230 |
| Apoptosis Sampler Kit | WR | | Rb | 1 kit | APT880 | $435 |
| Propidium Iodide Solution | | | | 1 mL | S7109 | $60 |
| Propidium Iodide/Antifade Solution | | | | 1 mL | S7112 | $60 |
| DAPI/Antifade Solution, Ready-to-Use | | | | 1 mL | S7113 | $60 |
| Antifade Solution | | | | 1 mL | S7114 | $60 |
| Staurosporine | | KA | | 200 µg | 19-123 | $179 |

# Custom antibody production

## Secondary antibody and custom services



Millipore provides custom services for both polyclonal and monoclonal antibody development tailored to your specific needs.

We offer several production scales, antibody purifications and conjugations giving you multiple options and meticulous characterization depending on your needs. Contact our expert team, we'll work with you to achieve successful completion of your custom project.

Millipore offers a comprehensive selection of affinity purified secondary detection antibodies and conjugates.

Select from our variety of whole and F(ab´)2 fragment antibodies with defined specificities, hosts and a growing range of conjugates useful in wide range of application.

Find the antibody for your specific application: www.millipore.com/chemicon.

*Millipore provides innovative tools, services and application expertise that improve the scientist's productivity in the pharmaceutical, academic, life science, applied science, clinical and government research sectors. Our product range spans water purification, protein research, analytical sample preparation, cell-based assays and high throughput screening. Please visit* ***www.millipore.com/bioscience*** *for more details.*

## Millipore Worldwide


**AUSTRALIA**
TO PLACE AN ORDER OR FOR TECH SUPPORT:
TEL 1800 252 265
03 9839 2000
FAX 03 9887 3912

**FRANCE**
TO PLACE AN ORDER:
TEL 0805 300 576
FAX 0805 300 579
FOR TECH SUPPORT:
TEL 0805 300 578

**GERMANY**
TO PLACE AN ORDER:
TEL 0800 759 8965
FAX 0800 759 8967
FOR TECH SUPPORT:
TEL 0800 759 8966

**SWEDEN**
TO PLACE AN ORDER:
TEL 040 22 42 00

**UK**
TO PLACE AN ORDER:
TEL 0800 0190 333
FAX 0800 0190 444
FOR TECH SUPPORT:
TEL 0800 0190 555

**UNITED STATES**
TO PLACE AN ORDER:
TEL 800 437 7500
FAX 951 676 9209
FOR TECH SUPPORT:
TEL 800 437 7500

*For additional contact information, visit us online at www.millipore.com.*


MILLIPORE



Lit. No. PB0002ENUS Printed in U.S.A. 1658-0506



upstate | CHEMICON
now part of Millipore