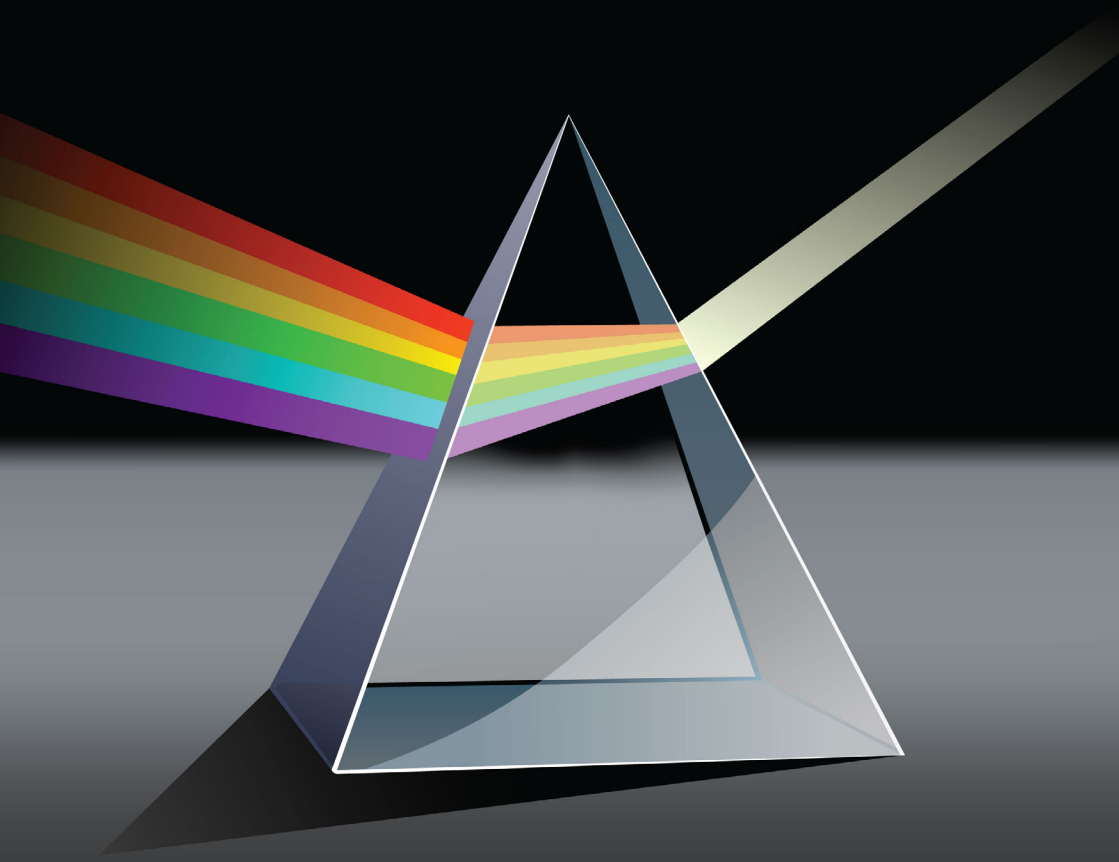
Phycobiliproteins & Tandem Conjugates

Multicolor Flow Cytometric Detection with Superior Fluorescence



AAT Bioquest®

Overview of Phycobiliproteins

Phycobiliproteins are a family of photosynthetic light-harvesting proteins derived from microalgae and cyanobacteria. These proteins contain covalently attached linear tetrapyrrole groups, known as phycobilins, which play a critical role in capturing light energy. In microalgae and cyanobacteria, energy absorbed by these phycobilins is efficiently transferred via fluorescence resonance energy transfer (FRET), to chlorophyll pigments for their use in photosynthetic reactions **(Figure 1)**. Because phycobiliproteins have extremely high fluorescence quantum yields and absorbance coefficients over a wide spectral range, they serve as valuable fluorescent tags in a variety of fluorescence applications, primarily flow cytometry. Phycobiliproteins conjugated to molecules having biological specificity (e.g. immunoglobulin, protein A or streptavidin) are effective tools in fluorescence activated cell sorting (FACS), imaging, immunophenotyping and immunoassay applications.

Compared to organic and synthetic fluorescent dyes, phycobiliproteins offer several advantages when used as fluorescent probes, including:

- Intense long-wavelength excitation and emission profiles to minimize auto-fluorescence from biological materials
- Minimal fluorescence quenching contributed by the covalent binding of phycobilins to the protein backbone
- Highly water-soluble to facilitate chemical manipulation for conjugation reactions
- Significantly large Stokes shifts with resolvable emission spectra for multicolor analysis
- Multiple sites for stable conjugation with organic and synthetic compounds such as antibodies, cyanine dyes or iFluor™ dyes

There are two main classes of phycobiliproteins typically utilized in fluorescence analyses which differ mainly in their protein structure, phycobilin content and fluorescent properties. These are the phycoerythrins (PE) and allophycocyanins (APC).

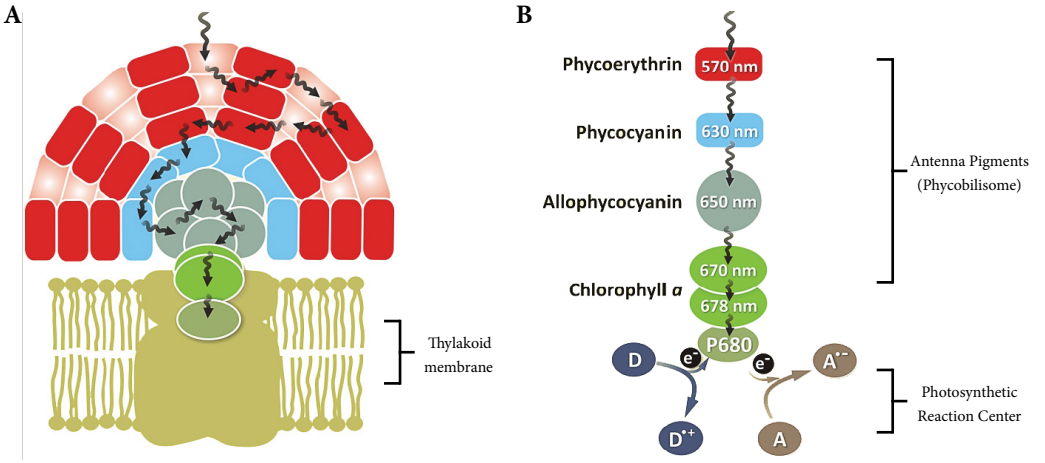


Figure 1. Schematic diagram of a phycobilisome situated on the thylakoid membrane **(A)** and the energy transfer steps which include charge separation **(B)**. Each phycobilisome contains a core consisting of allophycocyanins. From this core several rods made up of phycocyanin and phycoerythrin extend in an outward orientation and function as light harvesting antennae. Energy absorbed by these rods is efficiently transferred to the chlorophyll pigments for their use in photosynthetic reactions.

R-Phycoerythrin (R-PE) *Ammonium Sulfate Free*

Phycoerythrin (PE) is a large 240 kDa phycobiliprotein isolated from red algae. It exhibits an intensely bright red-orange fluorescence with an extinction coefficient (ε) of 1,960,000 $cm^{-1}M^{-1}$ and a quantum yield (Φ) of 0.84. PE has an absorbance spectrum characterized by three absorption bands, a primary absorbance peak at 565 nm and two secondary peaks at 496 nm and 545 nm. PE has a fluorescence emission maximum at 575 nm, which is in the yellow-orange region of the visible spectrum. In comparison to Cy3®, which has an extinction coefficient (ε) of 150,000 $cm^{-1}M^{-1}$ and a quantum yield (Φ) of 0.24, PE is significantly brighter **(Table 2)**.

PE materials are generally supplied concentrated in ammonium sulfate buffers, which require dialysis or other tedious protein purification processes prior to labeling. AAT Bioquest® is the only commercial vendor to offer ReadiUse™ PE (Cat# 2500) as a lyophilized solid, free of ammonium sulfate. Removal of ammonium sulfate eliminates the tedious protein purification processes and facilitates the rapid conjugation of PE to antibodies and other proteins such as streptavidin.

Table 1. Relative absorbance of PE at commonly used excitation wavelengths. Percentages shown are relative to the peak absorption of PE.

Protein	Laser Line	Relative Absorbance
Phycoerythrin	488 nm	66%
	543 nm	84%
	561 nm	97%

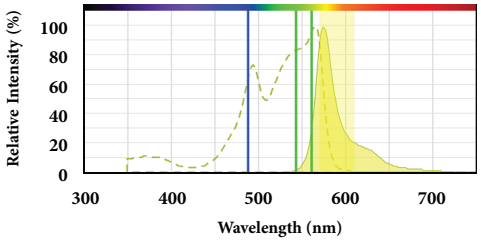


Figure 2. Absorption and emission spectra of ReadiUse™ PE (Cat# 2500). PE can be efficiently excited by the 488 nm laser (blue), the 543 nm laser (green) or the 561 nm laser (green-yellow), and visualized using a Cy3/TRITC filter set.

Table 2. Comparison of the spectral properties of phycoerythin and Cy3®

Properties	PE	Cy3®
Primary Absorbance Maximum (nm)	565	555
Secondary Absorbance Maximum (nm)	496, 545	None
Fluorescence Emission (nm)	575	565
Mol. Weight (Daltons)	240,000	829.03
ε_{max} ($cm^{-1}M^{-1}$)	1,960,000	~150,000
Fluorescence Quantum Yield	0.84	>0.15
Catalog No.	2500	271

Note: ε_{max} = extinction coefficient at their max absorption wavelength

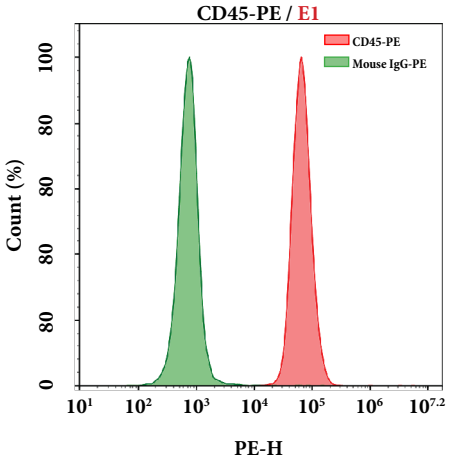


Figure 3. Jurkat cells stained with CD45-PE conjugate or Mouse IgG -PE (control). The conjugates were prepared with Buccutite™ Rapid PE Antibody Labeling Kit (Cat#1310), and the fluorescence signal was monitored using ACEA NovoCyte flow cytometer in PE channel.

Allophycocyanin (APC) *Ammonium Sulfate Free*

Allophycocyanin (APC) is a 105 kDA phycobiliprotein readily found in cyanobacteria and red algae. APC exhibits a bright far-red fluorescence with an extinction coefficient of 700,000 $cm^{-1}M^{-1}$ and a quantum yield (Φ) of 0.68. APC has a primary absorbance maximum at 652 nm with a secondary maximum at 625 nm, and a fluorescence emission maximum at 662 nm. In comparison to Cy5®, which also fluoresces in the red region, APC is significantly brighter and a much better choice for use in flow cytometry. This is due in part to the lower extinction coefficient (ε = 250,000 $cm^{-1}M^{-1}$) and quantum yield (Φ = 0.20) of Cy5® compared to APC (**Table 4**).

APC materials are generally supplied concentrated in ammonium sulfate buffers, which require dialysis or other tedious protein purification processes prior to labeling. AAT Bioquest® is the only commercial vendor to offer ReadiUse™ Cross Linked-APC (Cat# 2503) as a lyophilized solid, free of ammonium sulfate. Removal of ammonium sulfate eliminates these tedious protein purification processes and facilitates the rapid conjugation of APC to antibodies and other proteins such as streptavidin.

Table 3. Relative absorbance of APC at commonly used excitation wavelengths. Percentages shown are relative to the peak absorption of APC.

Protein	Laser Line	Relative Absorbance
Allophycocyanin	633 nm	74%
	647 nm	96%

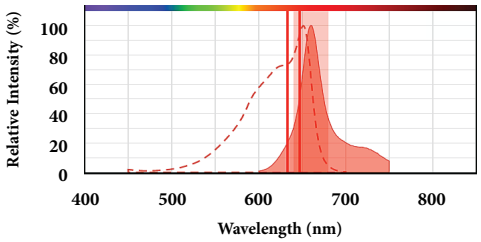


Figure 4. Absorption and emission spectra of ReadiUse™ CL-APC (Cat# 2503). APC can be efficiently excited by the 633 nm laser or 647 nm laser, and can be visualized using a Cy5 filter set.

Table 4. Comparison of the spectral properties of APC and Cy5®

Properties	APC	Cy5®
Primary Absorbance Maximum (nm)	652	649
Secondary Absorbance Maximum (nm)	625	None
Fluorescence Emission (nm)	662	665
Mol. Weight (Daltons)	105,000	855.07
ε_{max} ($cm^{-1}M^{-1}$)	700,000	~250,000
Fluorescence Quantum Yield	0.68	>0.28
Catalog No.	2503	151

Note: ε_{max} = extinction coefficient at their max absorption wavelength

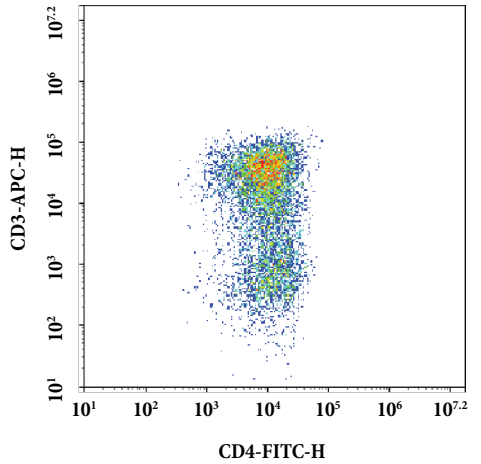


Figure 5. Human lymphocytes stained with CD3-APC and CD4-FITC conjugates. The fluorescence signal was monitored using ACEA NovoCyte flow cytometer in APC and FITC channel.

PE & APC Tandem Dyes

Tandem dyes are a unique class of fluorescent molecules that consist of two different covalently linked fluorophores, a donor (e.g. PE or APC) and a longer-wavelength emitting fluorescence acceptor (e.g. Cy5®, Cy7® or iFluor™ 750). Through fluorescence resonance energy transfer (FRET), energy from an excited donor fluorophore is transferred to an acceptor fluorophore resulting in a fluorescence emission characteristic of the acceptor. In flow cytometry, tandem dyes are ideally suited for multicolor analysis of cells due to their exploitation of a single excitation source and their significantly large Stokes shifts. Figures 1 and 2 illustrate the excellent spectral separation of tandem dyes for three and four multicolor analysis, respectively.

Table 5. Properties of APC and APC tandems illustrating their excellent spectral separation that enables three-color flow cytometric analysis.

Fluorophore	Ex (nm)	Em (nm)	Stokes Shift (nm)
APC	651	662	11
APC-iFluor™ 700	651	713	62
APC-iFluor™ 750	651	779	128

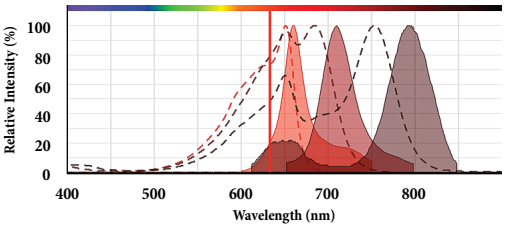


Figure 6. Absorption and emission spectra of APC (orange-red), APC-iFluor™ 700 (deep-red) and APC-iFluor™ 750 (NIR). All fluorophores are efficiently excited by the 633 nm laser (red).

Table 6. Properties of FITC, PE and PE tandems illustrating their excellent spectral separation that enables four-color flow cytometric analysis.

Fluorophore	Ex (nm)	Em (nm)	Stokes Shift (nm)
FITC	492	515	23
PE	496	575	79
PE-Cy5	496	670	174
PE-Cy7	496	780	284

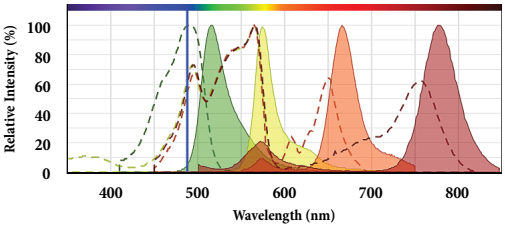


Figure 7. Absorption and emission spectra of FITC (green), PE (yellow), PECy5* (orange) and PE-Cy7* (red). All fluorophores are efficiently excited by the 488 nm laser (blue).

Table 7. Properties of PE and APC tandem dyes.

Cat. #	Tandem Dye	Ex (nm)	Em (nm)
2622	APC-Cy5.5	625, 651*	700
2625	APC-Cy7	625, 651*	780
2570	APC-iFluor™ 700	625, 651*	713
2571	APC-iFluor™ 750	625, 651*	779
2610	PE-Cy5	496, 545, 565*	670
2613	PE-Cy5.5	496, 545, 565*	700
2616	PE-Cy7	496, 545, 565*	780
2584	PE-iFluor™ 594	496, 545, 565*	619
2577	PE-iFluor™ 647	496, 545, 565*	674
2578	PE-iFluor™ 750	496, 545, 565*	779
2619	PE-Texas Red®	496, 545, 565*	600

Note: * = primary absorbance maximum

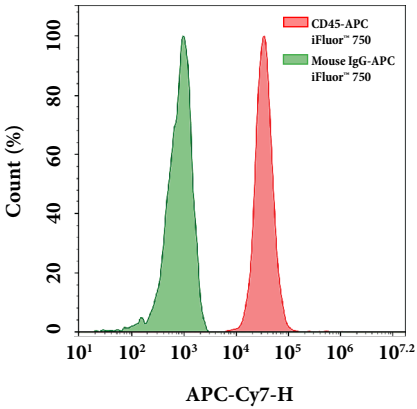


Figure 8. Jurkat cells stained with CD45-APC-iFluor™ 750 or Mouse IgG-APCi-Fluor™ 750 (control). Conjugates were prepared with ReadiUse™ Preactivated APC-iFluor™ 750 Tandem (Cat#2571). Fluorescence signal was monitored using ACEA NovoCyte flow cytometer in the APC-Cy7 channel.

ReadiUse™ Preactivated Phycobiliproteins

Typically, conjugates of phycobiliprotein are prepared using either SMCC crosslinking chemistry or pyridyldisulfide derivatives of PE or APC. Both techniques, however, require stringent labeling conditions and suffer from several drawbacks. For example, conjugation using SMCC crosslinkers suffers from self-polymerization, poor conjugation efficiency (approximately 30% recovery) and is typically performed at a pH of 7.2-7.5 (with NHS-ester reacted before or simultaneous with the maleimide reaction) to prevent hydrolytic degradation of its reactive moieties. Pyridyldisulfide derivatives of PE and APC require that the pyridyldisulfide groups be reduced to thiols before they are reacted with maleimide-derivatized proteins. Furthermore, pyridyldisulfide derivatives of PE and APC are highly unstable and must be used within months of receipt.

ReadiUse™ Preactivated PE, APC and their respective tandem conjugates utilize our Buccutite™ crosslinking technology to facilitate the rapid conjugation of phycobiliproteins to antibodies, streptavidin or other proteins bearing a high degree of biological specificity. Each ReadiUse™ Preactivated phycobiliprotein includes a phycobiliprotein pre-labeled with our proprietary linker Buccutite™ FOL and a 100 µg vial of linker Buccutite™ MTA. Antibodies of interest are labeled with Buccutite™ MTA, and upon mixing with FOL-modified phycobiliproteins readily react to yield highly stable phycobiliprotein-antibody conjugates. Compared to existing conjugation methods, such as SMCC chemistry, Buccutite™ crosslinking technology does not suffer from self-polymerization, requires less stringent labeling conditions, and has a significantly higher conjugation efficiency.

Additionally, phycobiliproteins can be conveniently crosslinked to other proteins using our Buccutite™ Rapid Antibody Labeling Kits, as described in the following section. Buccutite™ Rapid Antibody Labeling Kits include all the reagents, buffers, purification columns and detailed protocols to perform two phycobiliprotein-protein conjugations.

Table 8. Properties of ReadiUse™ PE, APC and tandem conjugates.

Cat. #	Phycobiliprotein	Ex (nm)	Em (nm)
2503	ReadiUse™ CL-APC *Ammonium Sulfate-Free*	625, 651*	662
2500	ReadiUse™ PE *Ammonium Sulfate-Free*	496, 545, 565*	575
2561	ReadiUse™ Preactivated APC	625, 651*	662
2586	ReadiUse™ Preactivated APC-Cy5.5 Tandem	625, 651*	700
2587	ReadiUse™ Preactivated APC-Cy7 Tandem	625, 651*	780
2570	ReadiUse™ Preactivated APC-iFluor™ 700 Tandem	625, 651*	713
2571	ReadiUse™ Preactivated APC-iFluor™ 750 Tandem	625, 651*	779
2560	ReadiUse™ Preactivated PE	496, 545, 565*	575
2580	ReadiUse™ Preactivated PE-Cy5 Tandem	496, 545, 565*	674
2581	ReadiUse™ Preactivated PE-Cy5.5 Tandem	496, 545, 565*	700
2582	ReadiUse™ Preactivated PE-Cy7 Tandem	496, 545, 565*	780
2584	ReadiUse™ Preactivated PE-iFluor™ 594 Tandem	496, 545, 565*	600
2577	ReadiUse™ Preactivated PE-iFluor™ 647 Tandem	496, 545, 565*	674
2578	ReadiUse™ Preactivated PE-iFluor™ 750 Tandem	496, 545, 565*	779
2583	ReadiUse™ Preactivated PE-Texas Red Tandem	496, 545, 565*	600

Note: * = primary absorbance maximum

Buccutite™ Rapid Antibody Labeling Kits

Buccutite™ Rapid Antibody Labeling Kits deliver a simplistic and robust approach for labeling microscale volumes of antibodies or proteins with phycobiliproteins and phycobiliprotein tandem conjugates. Analogous to the biotin-streptavidin conjugation method, Buccutite™ technology utilizes a unique pair of linkers, Buccutite™ MTA and Buccutite™ FOL. These two linkers are independently labeled onto the antibody and phycobiliprotein components, respectively, and when mixed will bind strongly to each other, resulting in a phycobiliprotein-labeled antibody conjugate (Figure 9). Compared to other conjugation chemistries, such as SMCC based-conjugation, Buccutite™ antibody labeling technology offers several advantages:

- Labeling can be completed in 1-2 hours under extremely mild conditions
- Buccutite™ reaction can be run in a broad temperature range and pH range of 5 to 9
- Optimized for labeling microscale volumes of 25 µg or 100 µg antibody per reaction
- No purification step required with 25 µg labeling kits
- Phycobiliprotein component of each kit is supplied pre-modified with the Buccutite™ FOL linker
- Buccutite™ MTA-labeled antibodies and Buccutite™ FOL-labeled phycobiliproteins are highly stable and can be stored separately at 4 °C for 1 to 2 years
- High conjugation efficiency

Buccutite™ Labeling Kits Include:

- Buccutite™ FOL-Activated Phycobiliprotein
- Buccutite™ MTA Linker
- Reaction Buffer
- Spin Column (Not required for 25 µg labeling kits)
- Detailed labeling protocol

Table 9. Spectral properties of PE, APC and tandem conjugates available in Buccutite™ Rapid Antibody Labeling Kits.

Cat. #	Label	Ex/Em (nm)	ε ($cm^{-1}M^{-1}$)max
1311	APC	625, 651*/662	700,000
1320	APC-Cy5.5	625, 651*/700	700,000
1321	APC-Cy7	625, 651*/780	700,000
1319	APC-iFluor™ 700	625, 651*/713	700,000
1310	PE	496, 545, 565*/575	1,960,000
1322	PE-Cy5	496, 545, 565*/674	1,960,000
1316	PE-Cy5.5	496, 545, 565*/700	1,960,000
1317	PE-Cy7	496, 545, 565*/780	1,960,000
1318	PE-Texas Red	496, 545, 565*/600	1,960,000
1325	PerCP	496, 545, 565*/677	350,000

Note: ε_{max} = extinction coefficient at their max absorption wavelength

* = primary absorbance peak

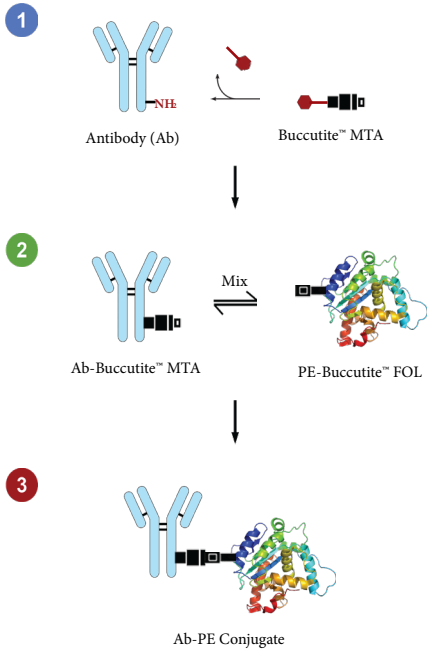


Figure 9. Conjugation scheme utilized in the Buccutite™ Rapid PE Antibody Labeling Kit (Cat# 1310). **(1)** An unlabeled antibody is modified with Buccutite™ MTA. **(2)** Ab-Buccutite™ MTA is mixed with preactivated PE-Buccutite™ FOL. **(3)** Ab-PE conjugate ready for use in immunoassay or flow cytometric applications.

Phycobiliprotein-Labeled Streptavidin Conjugates

Streptavidin-phycobiliprotein conjugates are potent second-step reagents used in conjunction with biotinylated antibodies. The high binding affinity of streptavidin for biotin generates a stable non-covalent complex resistant to many adverse conditions that would normally result in dissociation (e.g. organic solvents, denaturants and extreme temperatures or pH). Common applications of streptavidin-biotin include: indirect immunofluorescent staining of cells for flow cytometric analysis (Figure 10), as well as, microarrays, ELISA and other applications which require either high sensitivity or concurrent multicolor analysis.

AAT Bioquest® offers PE, APC and tandem conjugates of streptavidin that have been highly purified to ensure conjugates are free of all unconjugated streptavidin and phycobiliproteins in order to minimize background interference and nonspecific staining. Conjugates are labeled in a 1:1 ratio of streptavidin to phycobiliprotein such that the biological activity of streptavidin and fluorescence characteristics of the phycobiliprotein are fully retained. Additionally, streptavidinAPC conjugates are prepared using chemically cross-linked APC to eliminate the dissociation of APC into its subunits at dilute concentrations.

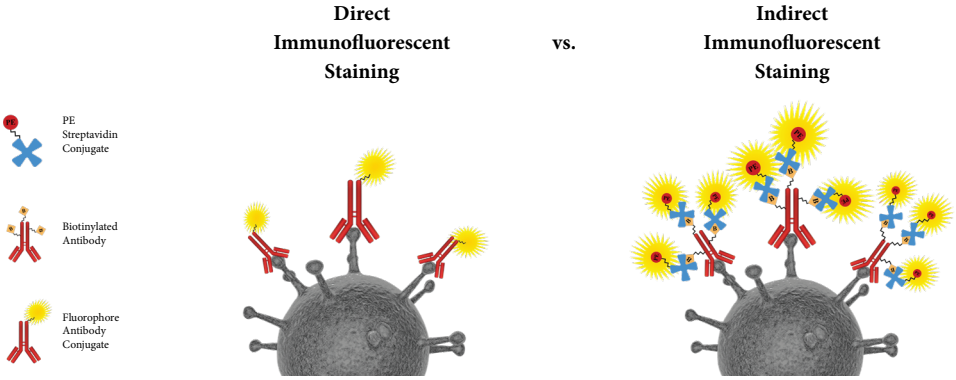


Figure 10. Diagram illustrating a direct immunofluorescent staining scenario using a fluorophore-antibody conjugate compared to a indirect immunofluorescent staining scenario using biotinylated primary antibodies with PE-streptavidin conjugates.

Table 10. Comparison of direct and indirect immunofluorescent staining.

Staining	Direct	Indirect
Method	Single step staining process to detect antigens using specific fluorochrome labeled antibody conjugates.	A two-step staining process where antigens are first detected using biotinylated primary antibodies and then secondary PE-streptavidin conjugates are used to detect the primary.
Adavantages	• Rapid single-step staining • Can use multiple antiboides from same host	• Increased sensitivity • Signal amplification • Relatively inexpensive • No species cross-reactivity
Disadvantages	• No signal amplification • Limited flexibility • Expensive • Lower sensitivity	Multi-step staining process

Phycobiliprotein-Annexin V Conjugates

Phycobiliprotein conjugates of annexin V are highly fluorescent and sensitive probes for examining the externalization of phosphatidylserine (PS), a hallmark indicator of the early-to-intermediate stages of apoptosis. During the initial stages of apoptosis, the cell's membrane destabilizes allowing for PS to translocate from the cytoplasmic side of the cell to the outer leaflets of the cell membrane. Once externalized, binding sites on PS become readily available for annexin V, a calcium-dependent phospholipid-binding protein, to detect.

AAT Bioquest® PE-annexin V and APC-annexin V conjugates can be used in combination with viability dyes, such as nucleic acid stains, to accurately determine the percentage of apoptotic and non-apoptotic cells within a heterogeneous population using flow cytometric analysis.

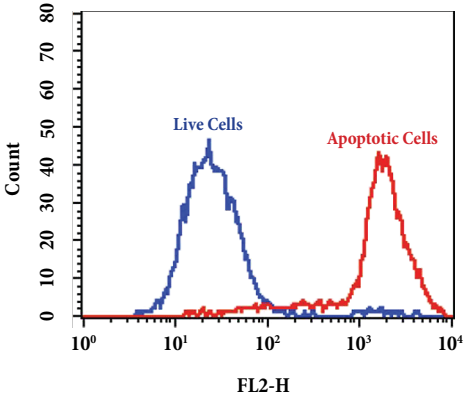


Figure 11. The detection of binding activity of PE-Annexin V to phosphatidylserine in Jurkat cells with Cell Meter™ PE-Annexin V Binding Apoptosis Assay Kit. Jurkat cells were treated without (Blue) or with 1 µM staurosporine (Red) in a 37 °C, 5% CO_2 incubator for 4-5 hours, and then dye loaded with PE-Annexin V for 30 minutes. The fluorescence intensity of PE-Annexin V was measured with a FACSCalibur (Becton Dickinson) flow cytometer using the FL2 channel.

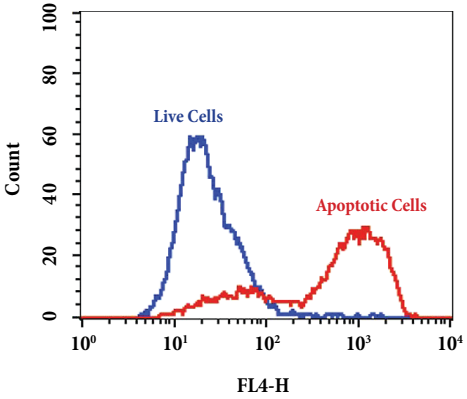


Figure 12. The detection of binding activity of APC-Annexin V to phosphatidylserine in Jurkat cells with Cell Meter™ APC-Annexin V Binding Apoptosis Assay Kit. Jurkat cells were treated without (Blue) or with 1 µM staurosporine (Red) in a 37 °C, 5% CO_2 incubator for ~4 hours, and then dye loaded with APC-Annexin V for 30 minutes. The fluorescence intensity of APC-Annexin V was measured with a FACSCalibur (Becton Dickinson) flow cytometer using the FL4 channel.

Table 11. Product information for PE and APC annexin V apoptosis assay kits.

Cat. #	Product	Ex (nm)	Em (nm)
22837	Cell Meter™ APC-Annexin V Binding Apoptosis Assay Kit *Optimized for Flow Cytometry*	625, 651*	662
22838	Cell Meter™ PE-Annexin V Binding Apoptosis Assay Kit *Optimized for Flow Cytometry*	496, 545, 565*	575

Note: * = primary absorbance maximum

Product Ordering Information For PE & APC

Cat #	Product Name	Unit Size	Ex/Em (nm)
2554	APC [Allophycocyanin]	1 mg	651/662
2555	APC [Allophycocyanin]	10 mg	651/662
2622	APC-Cy5.5 Tandem	1 mg	651/700
2625	APC-Cy7 Tandem	1 mg	651/780
16873	APC-Cy7® tandem-labeled goat anti-rabbit IgG (H+L)	100 µg	651/780
16908	APC-iFluor™ 750-streptavidin conjugate	100 µg	651/779
16902	APC-streptavidin conjugate	100 µg	651/662
1311	Buccutite™ Rapid APC Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	651/662
1313	Buccutite™ Rapid APC Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	651/662
1320	Buccutite™ Rapid APC-Cy5.5 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	651/700
1350	Buccutite™ Rapid APC-Cy5.5 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	651/700
1321	Buccutite™ Rapid APC-Cy7 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	651/780
1351	Buccutite™ Rapid APC-Cy7 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	651/780
1319	Buccutite™ Rapid APC-iFluor™ 700 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	651/713
1347	Buccutite™ Rapid APC-iFluor™ 700 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	651/713
1310	Buccutite™ Rapid PE Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	565/575
1312	Buccutite™ Rapid PE Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	565/575
1322	Buccutite™ Rapid PE-Cy5 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	565/674
1340	Buccutite™ Rapid PE-Cy5 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	565/674
1316	Buccutite™ Rapid PE-Cy5.5 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	565/700
1341	Buccutite™ Rapid PE-Cy5.5 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	565/700
1317	Buccutite™ Rapid PE-Cy7 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	565/780
1342	Buccutite™ Rapid PE-Cy7 Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	565/780
1325	Buccutite™ Rapid PerCP Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	482/677
1353	Buccutite™ Rapid PerCP Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	482/677
1318	Buccutite™ Rapid PE-Texas Red Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 100 µg Antibody Per Reaction*	2 Labelings	565/600
1343	Buccutite™ Rapid PE-Texas Red Tandem Antibody Labeling Kit *Microscale Optimized for Labeling 25 µg Antibody Per Reaction*	2 Labelings	565/600

Product Ordering Information For PE & APC

Cat #	Product Name	Unit Size	Ex/Em (nm)
1315	Buccutite™ Rapid Protein Crosslinking Kit *Microscale Optimized for Crosslinking 100 µg Antibody Per Reaction*	2 Labelings	N/A
2549	CL-APC [Cross linked-AlloPhycocyanin]	10 mg	651/662
2550	CL-APC [Cross linked-AlloPhycocyanin]	50 mg	651/662
2551	CL-APC [Cross linked-AlloPhycocyanin]	100 mg	651/662
2552	CL-APC [Cross linked-AlloPhycocyanin]	1 mg	651/662
2553	C-PC [C-Phycocyanin] *CAS 11016-15-2*	1 mg	616/647
2556	PE [R-Phycoerythrin] *CAS 11016-17-4*	10 mg	565/575
2557	PE [R-Phycoerythrin] *CAS 11016-17-4*	100 mg	565/575
2558	PE [R-Phycoerythrin] *CAS 11016-17-4*	1 mg	565/575
2610	PE-Cy5 Tandem	1 mg	565/674
2613	PE-Cy5.5 Tandem	1 mg	565/700
2616	PE-Cy7 Tandem	1 mg	565/780
2540	PerCP [Peridinin-Chlorophyll-Protein Complex]	10 mg	482/677
2559	PerCP [Peridinin-Chlorophyll-Protein Complex]	1 mg	482/677
16905	PerCP-streptavidin conjugate	100 µg	482/677
2619	PE-Texas Red Tandem	1 mg	565/600
2503	ReadiUse™ CL-APC [Cross linked-AlloPhycocyanin]	1 mg	651/662
2504	ReadiUse™ CL-APC [Cross linked-AlloPhycocyanin]	10 mg	651/662
2500	ReadiUse™ PE [R-Phycoerythrin]	1 mg	565/575
2501	ReadiUse™ PE [R-Phycoerythrin]	10 mg	565/575
2561	ReadiUse™ Preactivated APC	1 mg	651/662
2586	ReadiUse™ Preactivated APC-Cy5.5 Tandem	1 mg	651/700
2587	ReadiUse™ Preactivated APC-Cy7 Tandem	1 mg	651/780
2570	ReadiUse™ Preactivated APC-iFluor™ 700 Tandem	1 mg	651/713
2571	ReadiUse™ Preactivated APC-iFluor™ 750 Tandem	1 mg	651/779
2560	ReadiUse™ Preactivated PE	1 mg	565/575
2580	ReadiUse™ Preactivated PE-Cy5 Tandem	1 mg	565/674
2581	ReadiUse™ Preactivated PE-Cy5.5 Tandem	1 mg	565/700
2582	ReadiUse™ Preactivated PE-Cy7 Tandem	1 mg	565/780
2584	ReadiUse™ Preactivated PE-iFluor™ 594 Tandem	1 mg	565/614
2577	ReadiUse™ Preactivated PE-iFluor™ 647 Tandem	1 mg	565/674
2578	ReadiUse™ Preactivated PE-iFluor™ 750 Tandem	1 mg	565/779
2583	ReadiUse™ Preactivated PE-Texas Red Tandem	1 mg	565/600
16906	RPE-iFluor™ 647-streptavidin conjugate	100 µg	565/674
16907	RPE-iFluor™ 750-streptavidin conjugate	100 µg	565/779
16900	RPE-streptavidin conjugate	100 µg	565/575
16901	RPE-streptavidin conjugate	1 mg	565/575

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