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ab207489 Phospho-STAT6 (Y641) + Total In-Cell ELISA Kit (Chemiluminescent)

For the quantitative measurement of total and Y641phosphorylated STAT6 in adherent and non-adherent cells.

This product is for research use only and is not intended for diagnostic use.

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1. Overview

Phospho-STAT6 (Y641) + Total In-Cell ELISA Kit (Chemiluminescent) (ab207489) provides a simple, efficient, cell-based method to monitor proteins activated by phosphorylation. The kit is designed specifically to quantify activated (phosphorylated) STAT6 and/or total STAT6. Cells are cultured in 96-well plates and stimulated to induce the pathway of interest. Following stimulation, the cells are rapidly fixed to preserve activation-specific protein modifications. Each well is then incubated with a primary antibody that recognizes either phosphorylated STAT6 or total STAT6. Subsequent incubation with secondary HRP-conjugated antibody and developing solution provides an easily quantified chemiluminescent readout. The relative number of cells in each well is then determined using the provided Crystal Violet solution. The 96-well plate format is suitable for high-throughput screening applications.

The Phospho-STAT6 (Y641) + Total In-Cell ELISA Kit (Chemiluminescent) contains two 96-well plates and two primary antibodies. The phospho-STAT6 antibody is specific for phosphorylated STAT6 and was raised against a synthetic phospho-peptide corresponding to residues surrounding Tyrosine 641 of mouse STAT6. The total-STAT6 antibody recognizes STAT6 proteins regardless of the phosphorylation state. The kit can be used to study phosphorylated STAT6 relative to cell number or to determine STAT6 phosphorylation relative to the total STAT6 protein found in the cells. Once the phospho-STAT6 and total-STAT6 signals have been normalized for cell number, a comparison of the ratio of phosphorylated STAT6 to total STAT6 for each of the cell growth conditions can be made. The provided total-STAT6 antibody can be used as a positive control to demonstrate that the cells contain STAT6, the kit reagents are functional and that the protocol is performed correctly. Also, because fixed cells are stable for several weeks, you can prepare many plates simultaneously and then perform the assay when desired.

STAT (signal transducers and activators of transcription) comprise a family of latent cytoplasmic proteins that are activated to participate in gene control when cells encounter various extracellular polypeptides. Their critical role in development and normal cell signaling has been largely determined through the analysis of transgenic mice lacking individual STAT genes.

The STAT proteins are unique among transcription factors in containing an SH2 (src-homology 2), phosphotyrosine-binding domain, a common protein-protein interaction domain among signaling proteins. Tyrosine phosphorylation around residue 700 is essential for the dimerization of STATs and the concomitant nuclear translocation of the dimer. Ligand-activated receptors that catalyze this phosphorylation include receptors with intrinsic tyrosine kinase activity (epidermal growth factor (EGF), platelet-derived growth factor (PDGF) and colony-stimulating factor-1) as well as receptors that lack intrinsic tyrosine kinase activity but to which Janus kinases (JAKs) are noncovalently associated. Receptors to which JAKs are bound are often referred to as cytokine receptors. Their ligands include IFN- α , - β and - γ ; interleukins (IL) 2 to 7, 10 to 13, and 15; and erythropoietin, growth hormone, prolactin, thrombopoietin and other polypeptides. STAT dimers and heterodimers, but not monomers, are competent to bind DNA. The known DNA binding heterodimers are STAT1:2 (strong binding requires the joint presence of another protein, p48) and STAT1:3. STATs that form homodimers that bind DNA include STAT 1, 3, 4, 5 (STAT5A and 5B interact in a manner equivalent to a heterodimer) and 6.

STAT proteins are involved in a wide variety of biological pathways. STAT1 is involved in the activation of IFN α and IFN γ genes, STAT2 in the activation of IFN α genes, STAT4 and STAT6 in T-helper cell development and STAT5 in milk production. Disruption of STAT functions in mouse leads to several defects such as immune deficiency (STAT1), embryonic lethality (STAT2), lack of gastrulation (STAT3), T-helper 1 cell dysfunction (STAT4), lack of lactation (STAT5A, 5B) and T-helper 2 cell dysfunction (STAT6). The disruption of STAT signaling blocks neoplastic transformation, thus making inhibitors of STAT proteins candidates for the treatment of cancer.

In most cases, STAT activation is transient. Inactivation of STAT proteins is carried out by several mechanisms, including dephosphorylation of STAT proteins in the nucleus and degradation through the ubiquitin-proteasome pathway. A novel family of negative feedback inhibitors of the JAK-STAT pathway has been identified, referred to as suppressor-of-cytokine-signaling (SOCS) proteins/JAK binding (JAB) proteins, and STAT-induced STAT inhibitors (SSIs).

2. Protocol Summary

Culture cells and treat as desired



Fix cells by replacing the growth medium with 4% (adherent cells) or 8% (non-adherent cells) formaldehyde in PBS for 20 minutes at RT. Wash cells



Quench endogenous peroxidase by incubating in Quenching Buffer for 20 minutes at RT. Wash cells



Incubate with Antibody Blocking Buffer for 1 hour at RT. Wash cells



Incubate with primary antibody overnight at +4°C. Wash cells



Incubate with secondary antibody for 1 hour at RT. Wash cells



Add Chemiluminescent Working Solution and read chemiluminescence using a luminometer or CCD camera system



Crystal Violet cell staining (Optional)

3. Precautions

Please read these instructions carefully prior to beginning the assay.

- All kit components have been formulated and quality control tested to function successfully as a kit.
- We understand that, occasionally, experimental protocols might need to be modified to meet unique experimental circumstances. However, we cannot guarantee the performance of the product outside the conditions detailed in this protocol booklet.
- Reagents should be treated as possible mutagens and should be handled with care and disposed of properly. Please review the Safety Datasheet (SDS) provided with the product for information on the specific components.
- Observe good laboratory practices. Gloves, lab coat, and protective eyewear should always be worn. Never pipet by mouth. Do not eat, drink or smoke in the laboratory areas.
- All biological materials should be treated as potentially hazardous and handled as such. They should be disposed of in accordance with established safety procedures.
- Sodium Azide and Formaldehyde are highly toxic chemicals. Appropriate safety precautions (gloves and eye protection) should be used. In addition, formaldehyde is highly toxic by inhalation and should be used only in a ventilated hood.

4. Storage and Stability

Store kit at -20°C immediately upon receipt. Kit has a storage time of 1 year from receipt, providing components have not been reconstituted.

Refer to list of materials supplied for storage conditions of individual components. Observe the storage conditions for individual prepared components in the Materials Supplied section.

5. Limitations

- Assay kit intended for research use only. Not for use in diagnostic procedures.
- Do not mix or substitute reagents or materials from other kit lots or vendors. Kits are QC tested as a set of components and performance cannot be guaranteed if utilized separately or substituted.

6. Materials Supplied

Item	1 x 96 tests	5 x 96 tests	Storage Condition
Phospho-STAT6 antibody	9 μ L	5 x 9 μ L	-20°C
Total-STAT6 antibody	9 μ L	5 x 9 μ L	-20°C
Anti-rabbit HRP-conjugated IgG	2 x 11 μ L	10 x 11 μ L	+4°C
1X Antibody Blocking Buffer	22 mL	5 x 22 mL	-20°C
1X Antibody Dilution Buffer	30 mL	5 x 30 mL	-20°C
10X PBS	120 mL	5 x 120 mL	RT
10% Triton X-100	10 mL	5 x 10 mL	RT
Crystal Violet Solution	22 mL	5 x 22 mL	+4°C
Chemiluminescent Reagent	2 x 2 mL	10 x 2 mL	+4°C
Reaction Buffer	2 x 4 mL	10 x 4 mL	+4°C
1% SDS Solution	22 mL	5 x 22 mL	RT
96-well tissue culture plate	2	10	RT
Plate sealing tape	2	10	RT

7. Materials Required, Not Supplied

These materials are not included in the kit, but will be required to successfully perform this assay:

- Multi-channel pipettor.
- Multi-channel pipettor reservoirs.
- Rocking platform.
- Parafilm.
- Microplate spectrophotometer capable of reading at 595 nm for Crystal Violet staining.
- Microplate luminometer or CCD camera-coupled imaging system for chemiluminescent detection.
- Fresh 10% hydrogen peroxide (H_2O_2) in dH_2O (3 mL is required).
- 10 $\mu\text{g}/\text{mL}$ poly-L-Lysine (if using non-adherent cells).
- 10% Sodium Azide (NaN_3) in dH_2O (250 μL is required).
- 37% Formaldehyde (2.5 mL is required for adherent cells; 5.0 mL required for non-adherent cells).

8. Technical Hints

- This kit is sold based on number of tests. A 'test' simply refers to a single assay well. The number of wells that contain sample, control or standard will vary by product. Review the protocol completely to confirm this kit meets your requirements. Please contact our Technical Support staff with any questions.
- Selected components in this kit are supplied in surplus amount to account for additional dilutions, evaporation, or instrumentation settings where higher volumes are required. They should be disposed of in accordance with established safety procedures.
- Make sure all buffers and solutions are at room temperature before starting the experiment.
- Samples generating values higher than the highest standard should be further diluted in the appropriate sample dilution buffers.
- Avoid foaming or bubbles when mixing or reconstituting components.
- Avoid cross contamination of samples or reagents by changing tips between sample, standard and reagent additions.
- Ensure plates are properly sealed or covered during incubation steps.
- Make sure you have the right type of plate for your detection method of choice.
- Make sure the heat block/water bath and microplate reader are switched on before starting the experiment.

9. Reagent Preparation

- Equilibrate all reagents to room temperature (18-25°C) prior to use.
- Prepare only as much reagent as is needed on the day of the experiment.
- We provide an excess of buffer components in order to perform one 96-well assay with the phospho-STAT6 antibody and one 96-well assay with the total-STAT6 antibody.

9.1 1X PBS:

Prepare 1X PBS by adding 1 volume of 10X PBS (pH 7.4) to 9 volumes of dH₂O and mixing thoroughly.

9.2 Preparation of Fixing Buffer (4% or 8% Formaldehyde in PBS):

Fixing Buffer is used to fix cells after cell culturing. Prepare by adding formaldehyde to 1X PBS and mixing well. 4% formaldehyde is used with adherent cells; 8% formaldehyde is used with non-adherent cells. The recipe in the Quick Chart for Preparing Buffers is written for use with a stock solution of 37% formaldehyde.

9.3 Preparation of Wash Buffer (0.1% Triton X-100 in PBS):

Prepare Wash Buffer by adding the provided 10% Triton X-100 solution to 1X PBS and mixing thoroughly.

9.4 Quenching Buffer (Wash Buffer containing 1% H₂O₂ and 0.1% Sodium Azide):

Quenching Buffer is used to inactivate the cells' endogenous peroxidase activity. Prepare by adding fresh Sodium Azide and fresh hydrogen peroxide to the Wash Buffer.

9.5 Blocking Buffer:

Supplied ready-to-use. A small amount of white precipitate may form if thawed in a warm water bath. This does not interfere with buffer function.

9.6 Antibody Dilution Buffer:

Supplied ready-to-use. A small amount of white precipitate may form if thawed in a warm water bath. This does not interfere with buffer function.

9.7 Diluted phospho-STAT6 antibody:

Prepare by diluting the supplied antibody 1/500 in Antibody Dilution Buffer (see the Quick Chart for Preparing Buffers).

9.8 Diluted total-STAT6 antibody:

Prepare by diluting the supplied antibody 1/500 in Antibody Dilution Buffer (see the Quick Chart for Preparing Buffers).

9.9 Diluted HRP-conjugated secondary antibody:

Prepare by diluting the supplied antibody 1/1000 in Antibody Dilution Buffer (see the Quick Chart for Preparing Buffers).

9.10 Preparation of Chemiluminescent Working Solution:

The Chemiluminescent Reagent and Reaction Buffer should be warmed to room temperature before use. These components are light sensitive. Therefore, we recommend avoiding direct exposure to intense light during storage. Prior to use, place the Chemiluminescent Reagent and Reaction Buffer at room temperature for at least 1 hour. In a separate container, mix 1 volume of Chemiluminescent Reagent with 2 volumes of Reaction Buffer to prepare the Chemiluminescent Working Solution (see the Quick Chart for Preparing Buffers). The Chemiluminescent Working Solution is stable for several hours. After the Chemiluminescent Working Solution is aliquoted into the wells, discard the remaining solution.

9.11 1% SDS Solution:

Supplied ready-to-use. 1% SDS Solution is used in the Crystal Violet counting procedure to solubilize cells and release the dye for subsequent quantification at 595 nm.

9.12 Crystal Violet Solution:

Supplied ready-to-use. Crystal Violet is used to estimate the relative number of cells in each well. This stain binds to cell nuclei and gives an OD₅₉₅ reading that is proportional to cell number.

Quick Chart for Preparing Buffers

Reagents to prepare	Components	1 well	48 wells	96 wells	192 wells
Fixing Buffer for adherent cells	1X PBS	98 μ L	4.7 mL	9.41 mL	18.82 mL
	37% Formaldehyde	12 μ L	576 μ L	1.15 mL	2.30 mL
Fixing Buffer for non-adherent cells	1X PBS	86 μ L	4.13 mL	8.26 mL	16.51 mL
	37% Formaldehyde	24 μ L	1.15 mL	2.30 mL	4.61 mL
Wash Buffer	1X PBS	3.376 mL	162 mL	310 mL	620 mL
	10% Triton X-100	34.1 μ L	1.64 mL	3.27 mL	6.55 mL
Quenching Buffer	Wash Buffer	97.9 μ L	4.7mL	9.40 mL	18.8 mL
	10% H ₂ O ₂	11 μ L	528 μ L	1.06 mL	2.11 mL
	10% Sodium Azide	1.1 μ L	52.8 μ L	106 μ L	211 μ L
Diluted total-STAT6 antibody	Antibody Dilution Buffer	45 μ L	2.16 mL	4.32 mL	-
	Total-STAT6 antibody	0.09 μ L	4.3 μ L	8.6 μ L	-
Diluted phospho-STAT6 antibody	Antibody Dilution Buffer	45 μ L	2.16 mL	4.32 mL	-
	Phospho-STAT6 antibody	0.09 μ L	4.3 μ L	8.6 μ L	-
Diluted HRP-conjugated secondary antibody	Antibody Dilution Buffer	110 μ L	5280 μ L	10.56 mL	21.12 mL
	HRP-conjugated secondary antibody	0.11 μ L	5.28 μ L	10.56 μ L	21.12 μ L
1X PBS (for wash steps)	10X PBS	154 μ L	7.39 mL	14.78 mL	29.57 mL
	dH ₂ O	1.39 mL	66.53 mL	133.0 mL	266.1 mL
Chemiluminescent Working Solution	Chemiluminescent Reagent	18 μ L	864 μ L	1.728 mL	3.46 mL
	Reaction Buffer	36 μ L	1.728 mL	3.456 mL	6.91 mL

10. Sample Preparation

10.1 Adherent cell protocol:

10.1.1 Seed cells in the 96-well plate so that they will be approximately 80% confluent at the time of fixing, after they have been treated as desired. The growth area in each well of the 96-well plate is 0.32 cm². The provided plates are sterile and treated for tissue culture.

10.1.2 Grow and treat cells as desired.

10.1.3 Fix cells by replacing the growth medium with 100 µL of 4% formaldehyde in PBS. To minimize the escape of formaldehyde vapors, place a 10 cm x 17 cm piece of parafilm over the plate and then cover the plate with the lid. The covered plate can also be placed in a zip-lock bag. Incubate for 20 minutes at room temperature.

Δ Note: Formaldehyde is highly toxic. Confine vapors to a chemical hood and wear appropriate gloves and eye protection when using this chemical.

10.2 Non-Adherent Cell Protocol:

The protocol is suitable for use with non-adherent cells if the cells are cultured and fixed as follows:

10.2.1 Treat the 96-well culture plate with 10 µg/mL poly-L-Lysine for 30 minutes at 37°C. Wash twice for 5 minutes with PBS.

10.2.2 Seed 17,000 cells/well, or whatever amount is appropriate for your particular cell line.

10.2.3 Grow and treat cells as desired.

10.2.4 Fix cells by replacing the growth medium with 100 µL of 8% formaldehyde in PBS. Incubate for 20 minutes at room temperature.

Δ Note: Fixed cells are stable for several weeks. Several plates can be prepared simultaneously and then the assay performed when desired. Fixed cells should be stored refrigerated in a zip-lock or heat-sealed bag with the formaldehyde solution in the wells.

11. Assay Procedure

- Equilibrate all materials and prepared reagents to room temperature prior to use.
- We recommend that you assay all standards, controls and samples in duplicate.
- Prepare all reagents, working standards, and samples as directed in the previous sections.

11.1 Block cells

- 11.1.1 Remove formaldehyde solution and wash cells 3 times with 200 μ L Wash Buffer. Each wash step should be performed for 5 minutes with gentle shaking.
- 11.1.2 Remove Wash Buffer, add 100 μ L Quenching Buffer and incubate for 20 minutes at room temperature.
- 11.1.3 Remove Quenching Buffer and wash cells 2 times for 5 minutes each with 200 μ L Wash Buffer.
- 11.1.4 Remove Wash Buffer, add 100 μ L Antibody Blocking Buffer and incubate 1 hour at room temperature.

11.2 Binding of primary and secondary antibodies

Δ Note: Depending on experiment design, some wells may be incubated with diluted phospho antibody, some with total antibody and some with secondary antibody alone (negative controls). For negative control wells, incubate with 40 μ L Antibody Dilution Buffer during primary antibody incubation step.

- 11.2.1 Remove Antibody Blocking Buffer and wash cells 2 times with 200 μ L Wash Buffer.
- 11.2.2 Remove Wash Buffer, add 40 μ L of diluted primary antibody (or Antibody Dilution Buffer for negative control wells) and seal plate with sealing tape. Place a 10 cm x 17 cm piece of parafilm over the plate, cover with lid and incubate overnight at 4°C. Be sure that the plate is level and that each well is tightly sealed with the sealing tape to prevent evaporation.

Δ Note: In cells known to generate high amounts of phosphorylated-STAT6, a 3-hour primary antibody incubation is sufficient. For maximum sensitivity, an overnight incubation is recommended.

- 11.2.3 Remove primary antibody, wash cells 3 times for 5 minutes each with 200 μ L Wash Buffer.

- 11.2.4 Remove Wash Buffer, add 100 μ L diluted secondary antibody, cover plate with tissue culture plate lid or sealing tape, and incubate 1 hour at room temperature.
- 11.2.5 During this incubation, transfer the amount of Developing Solution required for the assay into a secondary container and leave at room temperature for at least an hour (avoid light).

11.3 Chemiluminescent detection

- 11.3.1 Remove secondary antibody, wash cells 3 times for 5 minutes with 200 μ L Wash Buffer and then 2 times for 5 minutes with 200 μ L 1X PBS.
- 11.3.2 Remove PBS from plate wells and add 50 μ L room temperature Chemiluminescent Working Solution to each well.
- 11.3.3 Read chemiluminescence using a luminometer or CCD camera system. Readings should be taken within 10 minutes to minimize changes in signal intensity.

Δ Note: The phospho-STAT6 and total-STAT6 antibodies can be used on equivalent cell cultures to determine the effects of various cell treatments on the ratio of phosphorylated STAT6 to total STAT6. However, if the signals obtained with the phospho-STAT6 antibody and the total-STAT6 antibody are identical, one cannot conclude that the treatment resulted in phosphorylation of 100% of the STAT6.

11.4 OPTIONAL - Crystal Violet cell staining

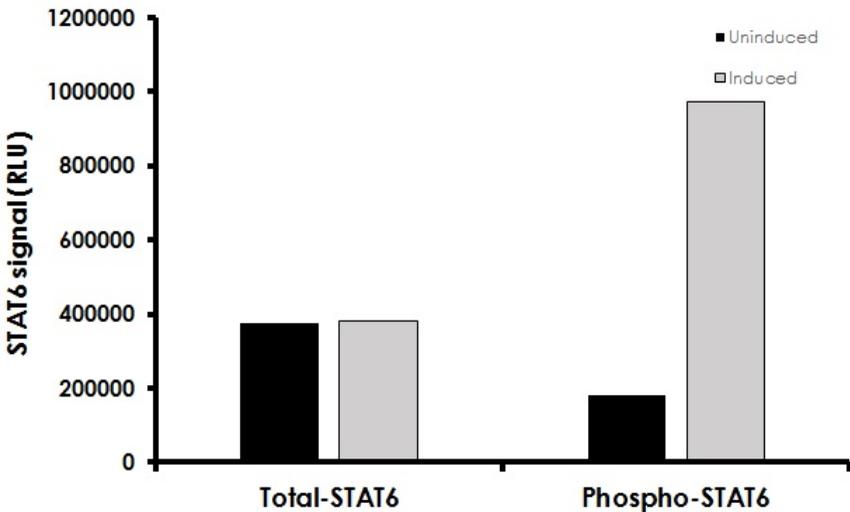
Crystal Violet is an intense stain that binds to the cell nuclei and gives an OD₅₉₅ reading that is proportional to cell number. If you wish to normalize your readings from above, simply follow the steps below.

- 11.4.1 After reading chemiluminescence, wash wells twice with 200 μ L Wash Buffer and 2 times with 200 μ L 1X PBS. Tap plates onto paper towels to remove excess liquid from wells and air-dry at room temperature for 5 minutes.
- 11.4.2 Add 100 μ L Crystal Violet solution to each well and incubate 30 minutes at room temperature.
Δ Note: Crystal Violet is an intense stain. Avoid contact with skin and clothing.
- 11.4.3 Wash wells 3 times with 200 μ L 1X PBS for 5 minutes each.
- 11.4.4 Add 100 μ L of 1% SDS Solution to each well and incubate on shaker for 1 hour at room temperature.
- 11.4.5 Read absorbance on a spectrophotometer at 595 nm. If the signals obtained are greater than the range of your

spectrophotometer, the signal can be reduced by removing some (*e.g.* 50 μ L) of the liquid from each well and replacing with an equivalent volume of dH₂O.

- 11.4.6 The measured OD₅₉₅ readings indicate the relative number of cells in each well. This relative cell number is then used to normalize each reading from Step 11.3.

12. Typical Data



Fig

Figure 1. Measurement of phosphorylated and total STAT6. NIH/3T3 cells were cultured in 96-well plates and serum-starved for 16 hours. Cells were then treated with 50 ng/mL PDGF for 5 minutes and fixed. Total and phospho STAT6, was each assayed in triplicate using the phospho and total STAT6 antibodies included in the kit. Data was plotted after correction for cell number (performed through use of Crystal Violet).

13. Assay Specificity

The phospho-STAT6 antibody is specific for phosphorylated STAT6 at Tyrosine 641 and does not cross-react with other sites. The total-STAT6 antibody recognizes STAT6 proteins regardless of the phosphorylation state.

14. Species Reactivity

This kit recognizes phosphorylated STAT6 from human and mouse origin and total STAT6 from human, mouse and rat origin.

15. Troubleshooting

Problem	Reason	Solution
No signal or weak signal in wells incubated with either phospho-STAT6 antibody or total-STAT6 antibody.	Omission of key reagent	Check that all reagents have been added in the correct order
	Substrate or conjugate is no longer active	Test conjugate and substrate for activity
	Enzyme inhibitor present	Sodium azide will inhibit the peroxidase reaction, follow our recommendations to prepare buffers
	Plate reader or CCD camera settings not optimal	Verify the wavelength (measurement mode) and filter settings in the plate reader
	Cells do not contain detectable levels of phospho STAT6 and/or total STAT6	Use Western blotting to confirm that cells contain detectable levels of protein(s) of interest.
	Insufficient number of cells were plated	Plate cells so that they are 80% confluent at time of fixing
	Cells did not adhere correctly to plate	Follow protocol for use of non-adherent cells
	Cells are not from correct origin	Follow protocol for use of non-adherent cells
	Excessive washing	Wash steps should be 5 minutes each
	Incubation of secondary antibody was too long	Incubate secondary antibody for 1 hour

High background in all wells	Measurement time too long	Reduce integration time or exposure time on luminometer or CCD camera
	Concentration of antibodies too high	Perform antibody titration to determine optimal working concentration. Start using 1/500 for the phospho- and the total-antibody and 1/2000 for the secondary antibody. The sensitivity of the assay will be decreased
	Inadequate washing	Ensure all wells are filled with Wash Buffer and follow washing recommendations
	Inadequate quenching or blocking	Ensure that quenching and blocking steps were performed according to the protocol
Uneven signal development	Incomplete washing of wells	Ensure all wells are filled with Wash Buffer and follow washing recommendations
	Well cross-contamination	Follow washing recommendations
No signal or weak signal in wells incubated with phospho-STAT6 antibody	Cell culture conditions did not induce phosphorylation of STAT6	Perform Western blot with phospho-STAT6 antibody to confirm that cells contain detectable levels of phosphorylated STAT6
Antibody solution evaporates from well during overnight incubation with primary antibody	Sealing tape was incorrectly applied	Ensure that each well is sealed when sealing tape is applied and ensure that the parafilm sheet covers the plate completely before the lid is placed on the plate. The plate can also be placed in a zip-lock or heat-sealed bag

<p>Insufficient sensitivity</p>	<p>Antibody concentration incorrect</p>	<p>If the cells studied have very low levels of the protein of interest, the sensitivity of detection may be improved by increasing the concentration of primary antibody used and by minimizing the incubation volume. It is possible to perform the overnight incubation in as little as 25 μL, however, this will make multichannel pipetting difficult and requires the plate be carefully sealed and incubated on a level surface. Alternatively, if the cells have easily detectable levels of the phosphorylated protein and the detection of small changes in phosphorylation is desired, sensitivity of the assay may be improved by decreasing the concentration of the phospho antibody used</p>
<p>Poor precision</p>	<p>Cross-well read through</p>	<p>The 96-well plates provided are designed to minimize signal cross-well contamination. If possible, do not use the phospho and total antibodies in adjoining wells. If this is not possible, use the total antibody at a higher dilution</p>

16. Notes

Technical Support

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