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1.0 OVERVIEW OF GENEBLAZER® TECHNOLOGY

GeneBLAzer® Beta-lactamase Reporter Technology provides a highly accurate, sensitive, and easy to use method of monitoring cellular responses to drug candidates or other stimuli (1). The core of the GeneBLAzer® Technology is a Fluorescence Resonance Energy Transfer (FRET) substrate that generates a ratiometric reporter response with minimal experimental noise. In addition to the two-color (blue/green) readout of stimulated and unstimulated cells, this ratiometric method reduces the absolute and relative errors that can mask the underlying biological response of interest. Such errors include variations in cell number, transfection efficiency, substrate concentration, excitation path length, fluorescence detectors, and volume changes. The GeneBLAzer® Beta-lactamase Reporter Technology has been proven effective in high-throughput screening (HTS) campaigns for a range of target classes, including G-protein coupled receptors (GPCRs) (2, 3), nuclear receptors (4-6), and kinase signaling pathways (7).

2.0 MATERIALS SUPPLIED

Cell Line Name:	MMTV- <i>bla</i> HeLa
Description:	CellSensor® MMTV- <i>bla</i> HeLa cells contain a beta-lactamase reporter gene under control of the MMTV response element) that has been stably integrated into HeLa cells. MMTV- <i>bla</i> HeLa cells respond to glucocorticoid receptor (GR) agonists such as cortisol and dexamethasone
Product Number:	K1279
Shipping Condition:	Dry Ice
Storage Condition:	Liquid nitrogen. Immediately upon receipt, cells must be stored in liquid nitrogen or thawed for immediate use. Cells stored at -80°C can quickly lose viability.
Quantity:	~2,000,000 (2x10 ⁶ cells/ml)
Application:	Detection of glucocorticoid receptor agonists
Growth Properties:	Adherent
Cell Phenotype:	Epithelial
Selection Marker:	Blasticidin (5 µg/ml)
Vector Used:	pLenti- <i>bsd</i> /MMTV- <i>bla</i> Vector
Mycoplasma Testing:	Negative
BioSafety Level:	2

3.0 MATERIALS REQUIRED, BUT NOT SUPPLIED

Media/Reagents	Recommended Source	Part #
LiveBLAzer™ –FRET B/G Loading Kit LiveBLAzer™ –FRET B/G Substrate (CCF4-AM), 5 mg DMSO for Solution A Solution B Solution C	Invitrogen	K1030 & K1095 Other sizes and Loading Kits are available
Recovery™ Cell Culture Freezing Medium	Invitrogen	12648-010
DMEM with GlutaMAX™	Invitrogen	10569-010
DMSO	Fluka	41647
Fetal bovine serum (FBS), dialyzed, tissue-culture grade (DO NOT SUBSTITUTE!)	Invitrogen	26400-044
Opti-MEM®-I with GlutaMAX™	Invitrogen	51985-034
Charcoal-stripped FBS	Invitrogen	12676-029
Nonessential amino acids (NEAA)	Invitrogen	11140-050
Penicillin/Streptomycin (antibiotic)	Invitrogen	15140-122
Phosphate-buffered saline without calcium and magnesium [PBS(-)]	Invitrogen	14190-136
HEPES (1 M, pH 7.3)	Invitrogen	15630-080
Dexamethasone	Sigma-Aldrich	D4902
0.05% Trypsin/EDTA	Invitrogen	25300-054
Blasticidin (antibiotic)	Invitrogen	R210-01
Solution D	Invitrogen	K1157

Consumables	Recommended Source	Part #
Black-wall, clear-bottom, 384-well assay plates (with low fluorescence background)	Corning Life Sciences	3712
Compressed air	Various	—

Equipment	Recommended Source
Fluorescence plate reader with bottom-read capability	Various
Filters, if required for plate reader (see Section 5.3)	Chroma Technology Corp.

3.1 Optional Equipment and Materials

- Epifluorescence- or fluorescence-equipped microscope with appropriate filters
- Microplate centrifuge

4.0 CELL CULTURE CONDITIONS

4.1 Media Required

Component	Thaw Medium	Growth Medium	Assay Medium	Freezing Medium
DMEM with GlutaMAX™	90%	90%	—	—
Opti-MEM®-I with GlutaMAX™	—	—	99%	—
Dialyzed FBS	10%	10%	—	—
Charcoal-stripped FBS	—	—	1%	—
NEAA	0.1 mM	0.1 mM	0.1 mM	—
HEPES (pH 7.3)	25 mM	25 mM	—	—
Penicillin (antibiotic)	100 U/ml	100 U/ml	100 U/ml	—
Streptomycin (antibiotic)	100 µg/ml	100 µg/ml	100 µg/ml	—
Sodium Pyruvate	—	—	1 mM	—
Blasticidin (antibiotic)	—	5 µg/ml	—	—
Recovery™ Cell Culture Freezing Medium	—	—	—	100%

Note: Unless otherwise stated, have all media and solutions at room temperature (we recommend 37°C for optimal performance) before adding them to the cells.

4.2 Growth Conditions

For detailed cell growth and maintenance directions, see **Section 7.0**.

Note: We recommend passing cells for three passages after thawing before using them in the beta-lactamase assay.

1. Thaw cells in Thaw Medium without Blasticidin and culture them in Growth Medium with Blasticidin. Pass or feed cells at least twice a week and maintain them in a 37°C/5% CO₂ incubator. Maintain cells between 10% and 90% confluency. Do not allow cells to reach confluence.
2. Freeze cells at 1-2 x 10⁶ cells/ml in Freezing Medium.

5.0 ASSAY PROCEDURE

The following instructions outline the recommended procedure for monitoring the dexamethasone-induced activation of the glucocorticoid receptor using LiveBLAzer™-FRET B/G Substrate as the readout. If you use alternative substrates (e.g., ToxBLAzer™ DualScreen, or LyticBLAzer™ Loading kits), follow the loading protocol provided with the product.

5.1 Quick Reference Guide

For more detailed protocol information, see **Section 5.2**.

Plate layouts and experimental outlines will vary; in screening mode, we recommend using at least three wells for each condition: Unstimulated, Stimulated, and Cell-free.

Note: Some solvents may affect assay performance. Assess the effect of a test compound solvent before screening. The cell stimulation described below is carried out in the presence of 0.5% DMSO to simulate the effect that a test compound solvent might have on the assay. If you use other solvents and/or solvent concentrations, change the following assay conditions and optimize appropriately.

	Unstimulated Wells	Stimulated Wells	Cell-free wells
Step 1 Plate cells	32 µl cells suspended in Assay Medium (12,500 cells/well)	32 µl cells suspended in Assay Medium (12,500 cells/well)	32 µl Assay Medium (no cells)
Step 2 Incubate cells	Incubate at 37°C/5% CO ₂ for 18 hours		
Step 3 Add DMSO	Prepare a stock of Assay Medium with 5% DMSO. Add 4 µl per well		
Step 4 Add agonist	4 µl Assay Medium	4 µl 10x Dexamethasone in Assay Medium	4 µl Assay Medium
Step 5 Incubate cells	Incubate the plate at 37°C/5% CO ₂ for 18 hours.		
Step 6 Prepare 6X Substrate Mixture	6 µl 1 mM LiveBLAzer™-FRET B/G Substrate (CCF4-AM) + 60 µl Solution B, mix. Add 900 µl Solution C and 60 µl Solution D, mix.		
Step 7 Load Substrate Mixture	Add 8 µl Substrate Mixture per well		
Step 8 Incubate Substrate + cells	Incubate plates for 2 hours at room temperature in the dark.		
Step 9 Detect Activity	See Section 5.3		
Step 10 Analyze data	See Section 6.0		

5.2 Detailed Assay Protocol

Plate layouts and experimental outlines will vary; in screening mode, we recommend using at least three wells for each control: Unstimulated Control, Stimulated Control, and Cell-free Control.

Note: Some solvents may affect assay performance. Assess the effects of solvent before screening. The cell stimulation described below is carried out in the presence of 0.5% DMSO to simulate the effect that a Test Compound solvent might have on the assay. If you use other solvents and/or solvent concentrations, change the following assay conditions and optimize appropriately.

5.2.1 Precautions

- Work on a dust-free, clean surface. Always handle the 384-well, black-wall, clear-bottom assay plate by the sides; do not touch the clear bottom of the assay plate.
- If pipetting manually, you may need to centrifuge the plate briefly at room temperature (30 seconds at 14 x g) after additions to ensure all assay components are on the bottom of the wells.
- Cells should be grown to reach 60 to 75% confluency (with medium change the day before the assay). Lower confluent cells will give lower response.

5.2.2 Plate Cells

1. Harvest cells from culture in Growth Medium and resuspend in Assay Medium at a density of 3.9×10^5 cells/ml.
2. Add 32 μ l per well of Assay Medium to the cell-free control wells. Add 32 μ l per well of the cell suspension to Unstimulated and Stimulated wells.
3. After plating, incubate the plates in a 37°C/5% CO₂ incubator for 18 hours.

5.2.3 Prepare Stock Solutions

1. Prepare Assay Medium with 5% DMSO.
2. Prepare 10X dexamethasone, at EC₈₀, in Assay Medium. We recommend preparing a dose response curve for dexamethasone to determine the EC₈₀ for your Stimulation Solution.

5.2.4 Stimulate Cells

1. Add 4 μ l Assay Medium with 5% DMSO to the Unstimulated, Stimulated and Cell-free wells.
2. Add 4 μ l 10X dexamethasone to Stimulated wells and 4 μ l Assay Medium to Unstimulated and Cell-free wells.
3. Incubate the assay plate in a humidified 37°C/5% CO₂ incubator for 18 hours.

5.2.5 Substrate Loading and Incubation

This protocol is designed for loading cells with LiveBLazer™-FRET B/G Substrate (CCF4-AM) or CCF2-AM. If alternative substrates are used please follow the loading protocol provided with the substrate.

Preparation of 6X LiveBLazer™-FRET B/G Substrate (CCF4-AM) or CCF2-AM Mixture and cell loading should be done in the absence of direct strong lighting. Turn off the light in the hood.

1. Prepare Solution A: 1 mM LiveBLazer™-FRET B/G Substrate (CCF4-AM, MW = 1096) stock solution in dry DMSO. Store the aliquots of the stock solution at -20°C until use.
2. Prepare 6X LiveBLazer™-FRET B/G (CCF4-AM) Substrate Mixture:
Add 6 μ l of Solution A to 60 μ l of Solution B and vortex.
Add 874 μ l Solution C and 60 μ l of Solution D to the combined solutions from above step with vortexing.
3. Remove assay plate from the humidified 37°C/5% CO₂ incubator.
4. Add 8 μ l of 6X Substrate Mixture from **Step 2** to each well.
5. Cover the plate to protect it from light and evaporation.
6. Incubate at room temperature for 2 hours.

5.3 Detection

All measurements using LiveBLazer™-FRET B/G Substrate are to be made at room temperature from the bottom of the wells, preferably in 384-well, black-wall, clear-bottom assay plates with low fluorescence background. Before reading the plate, remove dust from the bottom with compressed air.

Note: If you do not have access to a fluorescence plate reader with bottom-read capabilities, contact Technical Support for options of other beta-lactamase substrates that can be read with top-reading instruments.

5.3.1 Instrumentation, Filters, and Plates

- Fluorescence plate reader with bottom reading capabilities.
- Recommended filters for fluorescence plate reader:
Excitation filter: 409/20 nm
Emission filter: 460/40 nm
Emission filter: 530/30 nm

5.3.2 Reading an Assay Plate

1. Set the fluorescence plate reader to bottom-read mode.
2. Allow the lamp in the fluorescence plate reader to warm up for at least 10 minutes before making measurements.
3. Use the following filter selections:

	Scan 1	Scan 2
Purpose:	Measure fluorescence in the blue channel	Measure fluorescence in the green channel
Excitation filter:	409/20 nm	409/20 nm
Emission filter:	460/40 nm	530/30 nm

6.0 DATA ANALYSIS

6.1 Background Subtraction

We recommend that you subtract the background for both emission channels (460 nm and 530 nm).

1. Use the assay plate layout to identify the location of the Cell-free wells. These control wells are used for background subtraction.
2. Determine the average emission from the Cell-Free wells at both 460 nm (Average Blue Background) and 530 nm (Average Green Background).
3. Subtract the Average Blue Background (data collected at 460 nm) from all of the blue emission data.
4. Subtract the Average Green background (data collected at 530 nm) from all of the green emission data.
5. Calculate the Blue/Green Emission Ratio for each well, by dividing the background-subtracted blue emission values by the background-subtracted green emission values.

6.2 Visual Observation of Intracellular Beta-lactamase Activity Using LiveBLAzer™-FRET B/G Substrate (CCF4-AM)

Note: Microscopic visualization of cells will cause photobleaching. Always read the assay plate in the fluorescence plate reader before performing microscopic visualization.

An inverted microscope equipped for epifluorescence and either a xenon or mercury excitation lamp is typically required to view the LiveBLAzer™-FRET B/G Substrate (CCF4-AM) signal in cells. To visually inspect the cells, you will need a long-pass filter passing blue and green fluorescence light so that your eye can visually identify whether the cells are fluorescing green or blue.

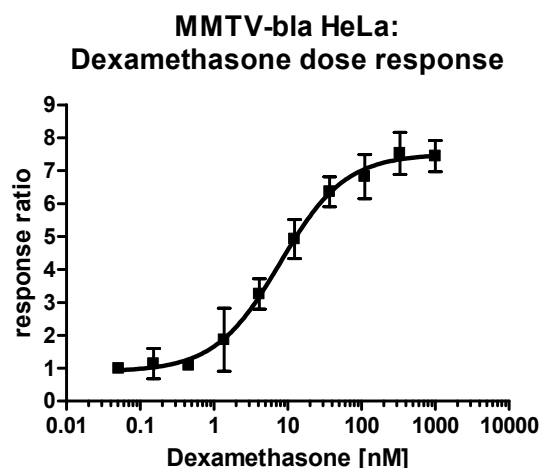
Recommended filter sets for observing beta-lactamase activity are described below and are available from Chroma Technologies (800-824-7662, www.chroma.com).

Chroma Set # 41031

Excitation filter:	HQ405/20x (405 ± 10 nm)
Dichroic mirror:	425 DCXR
Emission filter:	HQ435LP (435 long-pass)

Filter sizes vary for specific microscopes and need to be specified when the filters are ordered. For epifluorescence microscopes, a long-pass dichroic mirror is needed to separate excitation and emission light and should be matched to the excitation filter (to maximally block the excitation light around 405 nm, yet allow good transmission of the emitted light).

6.3 Representative Data



EC₅₀	8.1 nM
EC₈₀	31 nM
EC₁₀₀	123 nM
Z' at EC₁₀₀	0.68

Figure 1. Dose response of MMTV-*bla* HeLa cells to dexamethasone. MMTV-*bla* HeLa cells were treated with agonist dexamethasone over the indicated concentration range in a 384-well format. Cells were incubated for 18 hours with agonist and 0.5% DMSO and then combined with LiveBLAzer™-FRET B/G Substrate (CCF4-AM) for 2 hours. Fluorescence emission values at 460 nm and 530 nm were obtained using a standard fluorescence plate reader and the 460/530 ratios were plotted against the concentration of the agonist.

7.0 DETAILED CELL HANDLING PROCEDURES

7.1 Thawing Method

1. Place 14 ml of Thaw Medium without Blasticidin into a T75 flask.
2. Place the flask in a humidified 37°C/5% CO₂ incubator for 15 minutes to allow medium to equilibrate to the proper pH and temperature.
3. Remove the vial of cells to be thawed from liquid nitrogen and thaw rapidly by placing at 37°C in a water bath with gentle agitation for 1-2 minutes. Do not submerge vial in water.
4. Decontaminate the vial by wiping with 70% ethanol before opening in a Class II biological safety cabinet.
5. Transfer the vial contents drop-wise into 10 ml of Thaw Medium without Blasticidin in a sterile 15-ml conical tube.
6. Centrifuge cells at 200 × *g* for 5 minutes.
7. Aspirate supernatant and resuspend the cell pellet in 1 ml of fresh Thaw Medium without Blasticidin.
8. Transfer contents to the T75 tissue culture flask containing pre-equilibrated Thaw Medium without Blasticidin and place flask in a humidified 37°C/5% CO₂ incubator.
9. At first passage, switch to Growth Medium with Blasticidin.

7.2 Propagation Method

1. Cells should be passaged or fed at least twice a week. Cells should be maintained between 10% and 90% confluence. Do not allow cells to reach confluence.
2. To passage cells, aspirate medium, rinse once in PBS, add Trypsin/EDTA (3 ml for a T75 flask and 5 ml for a T175 flask and 8 ml for T225 flask) and swirl to coat the cells evenly. Cells usually detach after ~2–5 minutes exposure to Trypsin/EDTA. Add an equal volume of Growth Medium to inactivate Trypsin.
3. Verify under a microscope that cells have detached and clumps have completely dispersed.
4. Spin down cells and resuspend in Growth Medium.

7.3 Freezing Method

1. Harvest the cells as described in **Section 7.2**. After detachment, count the cells, then spin cells down and resuspend in 4°C Cell Culture Freezing Medium to 2 × 10⁶ cells/ml.
2. Dispense 1.0-ml aliquots into cryogenic vials.
3. Place in an insulated container for slow cooling and store overnight at –80°C.
4. Transfer to liquid nitrogen the next day for storage.

8.0 REFERENCES

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Use of Genetically Modified Organisms (GMO)

Information for European Customers The CellSensor™ ARE-*bla* HepG2 cell line(s) are genetically modified with the plasmids pLenti6M3 pLenti-*bsd* / ARE-*bla*. As a condition of sale, use of this product must be in accordance with all applicable local legislation and guidelines including EC Directive 90/219/EEC on the contained use of genetically modified organisms.