
Product Manual

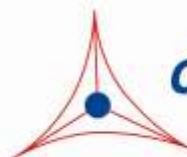
ViraSafe™ Lentiviral Expression System (Puro), Pantropic

Catalog Number

VPK-212-PAN

1 kit

FOR RESEARCH USE ONLY
Not for use in diagnostic procedures



CELL BIOLABS, INC.
Creating Solutions for Life Science Research

Introduction

Lentivirus vector based on the human immunodeficiency virus-1 (HIV-1) has become a promising vector for gene transfer studies. The advantageous feature of lentivirus vector is the ability of gene transfer and integration into dividing and non-dividing cells. The pseudotyped envelope with vesicular stomatitis virus envelope G (VSV-G) protein broadens the target cell range. Lentiviral vectors have been shown to deliver genes to neurons, lymphocytes and macrophages, cell types that previous retrovirus vectors could not be used. Lentiviral vectors have also proven to be effective in transducing brain, liver, muscle, and retina *in vivo* without toxicity or immune responses. Recently, the lentivirus system is widely used to integrate siRNA efficiently in a wide variety of cell lines and primary cells both *in vitro* and *in vivo*.

Lentivirus particles are produced from 293T cells through transient transfection of plasmids that encode for the components of the virion (Figure 1). Due to safety concerns regarding the infectious nature of HIV-1, recent lentiviral packaging systems have separated the viral components into 3 or 4 plasmids. However, these systems still present a small chance of generating replication-competent lentivirus upon recombination. In addition, most commercial lentiviral packaging systems provide plasmids containing the viral structure proteins in a premixed formulation, making it nearly impossible to optimize the ratio of the various plasmids for your particular experiment and host cell. Also, most commercial lentivirus transfer vectors contain promoters, antibiotic selection markers and/or reporter genes which may not be optimal or even suitable for your particular expression studies.

Cell Biolabs' ViraSafe™ Lentiviral Expression System provides a much safer method to package lentivirus, while still providing high viral titers. The sequence homology with native HIV-1 has been reduced by 80-90% even compared with other commercial third-generation packaging systems. In addition, each plasmid is provided separately rather than in a packaging mixture. This allows you the flexibility to amplify individual plasmids and optimize the ratio of plasmids for your experiment.

pSMPUW-Puro Lentiviral Expression Vector contains EF-1 α promoter ahead of the multiple cloning sites, followed by PGK promoter and puromycin resistant gene (Figure 2).

Key Features of ViraSafe™ Lentiviral Expression System:

1. Transfer Plasmid: Reduce extent of HIV sequences to increase capability up to 10 kb and reduce likelihood of recombination between vector components. Add elements to increase titer and further improve safety.
2. Packaging Plasmid: Improve the packaging plasmid to increase performance and reduce the likelihood of recombination between vector components.
 - a. Minimize HIV sequences – no accessory proteins, Tat or Rev, or LTRs
 - b. Prevent overlap with vector SM by codon wobbling Gag sequences
 - c. Boost particle production by incorporating adenovirus VA_I element
3. Flexible: All vectors including packaging vectors are provided separately to allow end-user to optimize the vector ratio for maximal lentivirus production.

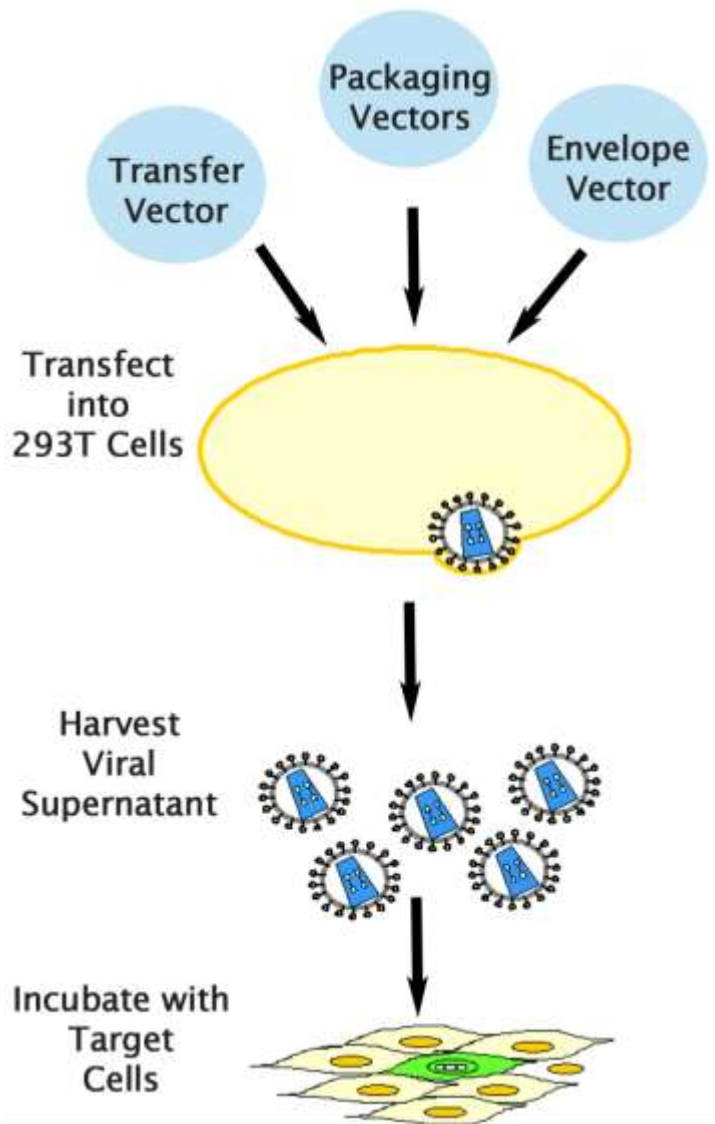
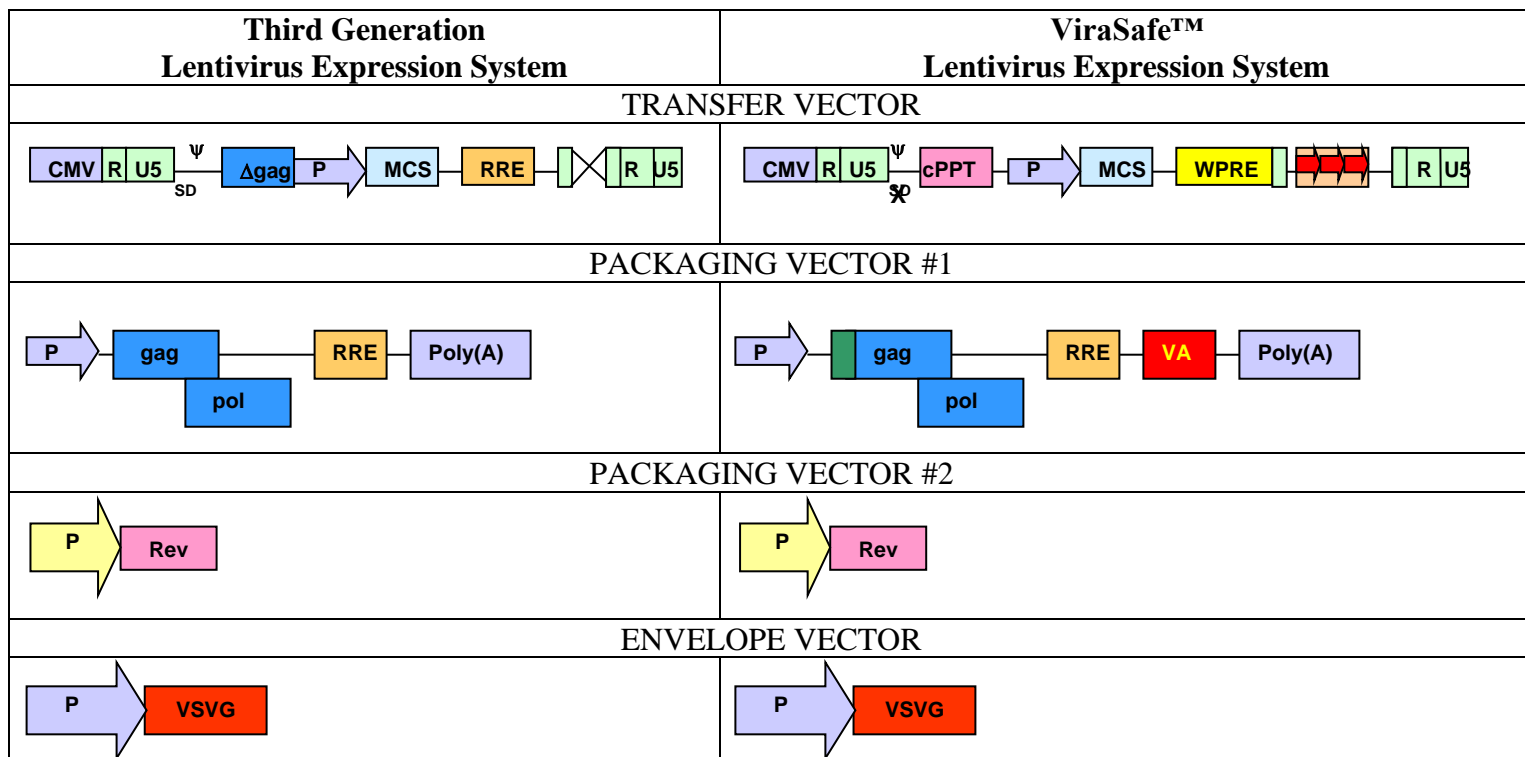


Figure 1. Lentivirus Production in 293T Cells

Related Products

1. LTV-100: 293LTV Cell Line
2. LTV-200: ViraDuctin™ Lentivirus Transduction Kit
3. LTV-300: GFP Lentivirus Control
4. VPK-107: QuickTiter™ Lentivirus Titer Kit (Lentivirus-Associated HIV p24)
5. VPK-108-H: QuickTiter™ Lentivirus Quantitation Kit (HIV p24 ELISA)
6. VPK-205: ViraSafe™ Lentivirus Packaging System, Ecotropic
7. VPK-211: pSMPUW Universal Lentiviral Expression Vector (Promoterless)

Unique Elements of the ViraSafe™ Lentivirus Expression System



Vector Name	Element	Name	Benefits compared to other 3 rd Generation Systems
ELEMENTS ADDED			
Transfer Vector		Central Polypurine Tract	<ul style="list-style-type: none"> Increased gene expression levels
		Hybrid 3' LTR Poly(A)	<ul style="list-style-type: none"> Increased safety: prevents read-through transcription Increased viral titer: vector transcript more stable in packaging cells
		WPRE	<ul style="list-style-type: none"> Increased viral titer
Packaging Vector #1		Codon Wobble	<ul style="list-style-type: none"> Increased safety: reduces sequence homology
		Adenovirus VA	<ul style="list-style-type: none"> Increased viral titer
ELEMENTS REMOVED			
Transfer Vector		Gag sequence	<ul style="list-style-type: none"> Increased safety: reduces sequence homology
		Rev-Responsive Element	<ul style="list-style-type: none"> Increased safety: reduces sequence homology

Kit Components

1. pSMPUW-Puro Lentiviral Expression Vector (Part No. VPK-212): One 40 μ L vial at 0.25 mg/mL. The plasmid is kanamycin resistant. The plasmid is kanamycin resistant.

Note: Please see Figure 2 for important instructions on bacterial culture of this plasmid.

2. pRSV-Rev Packaging Vector (Part No. 320022): One 40 μ L vial at 0.25 mg/mL.
3. pCMV-VSV-G Envelope Vector (Part No. RV-110): One 40 μ L vial at 0.25 mg/mL.
4. pCgpV Packaging Vector (Part No. 320024): One 40 μ L vial at 0.25 mg/mL.
5. pSMPUW-LacZ Control Vector (Part No. 320025): One 40 μ L vial at 0.25 mg/mL containing a nuclear localized LacZ driven by MND retroviral LTR promoter. The plasmid is kanamycin resistant. The plasmid is kanamycin resistant.

Note: Please see Figure 2 for important instructions on bacterial culture of this plasmid.

Materials Not Supplied

1. 293T cells: we recommend 293LTV Cell Line (Cat.# LTV-100) for high titer production of lentivirus.
2. Cell Culture Medium
3. Transfection Reagents

Storage

Store all components at -20°C .

Safety Considerations

Remember that you will be working with samples containing infectious virus. Follow the recommended NIH guidelines for all materials containing BSL-2 organisms. The ViraSafe™ Lentiviral Expression System is designed to minimize the chance of generating replication-competent lentivirus, but precautions should still be taken to avoid direct contact with viral supernatants.

Lentivirus Production

1. One day before transfection, plate sufficient 293T cells or 293LTV cells (Cat. # LTV-100) to achieve 70-80% confluence on the day of transfection.
2. Transfect cells by Calcium Phosphate or other transfection reagents.

Note: We suggest transfecting cells with FuGENE® Transfection Reagent (Roche Applied Science) or Lipofectamine™ Plus (Invitrogen). We recommend the ratio of vectors at 3:1:1:1 (pSMPUW: pCMV-VSV-G:pRSV-REV:pCgpV).

3. Harvest lentiviral supernatant 36-72 hours after transfection. Supernatant can be harvested 2 or 3 times, every 12 hours. Keep it at 4°C over the collecting period.
4. Pool the collected supernatants, centrifuge 5 minutes at 1500 rpm to remove cell debris and filtrate on 0.22 µm.
5. Supernatants can be used directly or purified/concentrated if needed. For long term storage, store supernatant at -80°C in aliquots.

Post-Packaging Considerations

Packaging your lentivirus is only the first step to ensuring successful expression of your gene. The following steps should be considered prior to infection of your host cell:

1. **Concentration and purification of your lentivirus:** Because of the latent nature of lentivirus, it is imperative that your virus be highly concentrated before infecting your host cell. Also, impurities from your viral supernatant can decrease the efficiency of infection.
2. **Measure the titer of your lentivirus:** This is an important step to ensure consistent viral transduction into your host cell. However, QPCR or stable clone counting can take as much as 1-2 weeks to perform. Traditional p24 ELISA kits can greatly overestimate your lentiviral titer. Our advanced p24 ELISA, QuickTiter™ Lentivirus Titer Kit (Catalog # VPK-107), uses exclusive technology that eliminates free p24 from your supernatant, giving you much more accurate lentiviral titers. Results are obtained in 6-18 hours.
3. **Use transduction reagents to increase infection efficiency:** Many cells are difficult to infect with lentivirus, and without supplemental reagents transduction efficiencies can be low. Reagents such as Polybrene® can help, but are often insufficient. Cell Biolabs' proprietary reagents in our ViraDuctin™ Lentivirus Transduction Kit (Catalog # LTV-200) form a super-complex with your virus to increase transduction efficiencies by promoting virus and cell interaction.

Example of Results

The following figure demonstrates typical results seen with Cell Biolabs ViraSafe™ Lentiviral Expression System. One should use the data below for reference only.

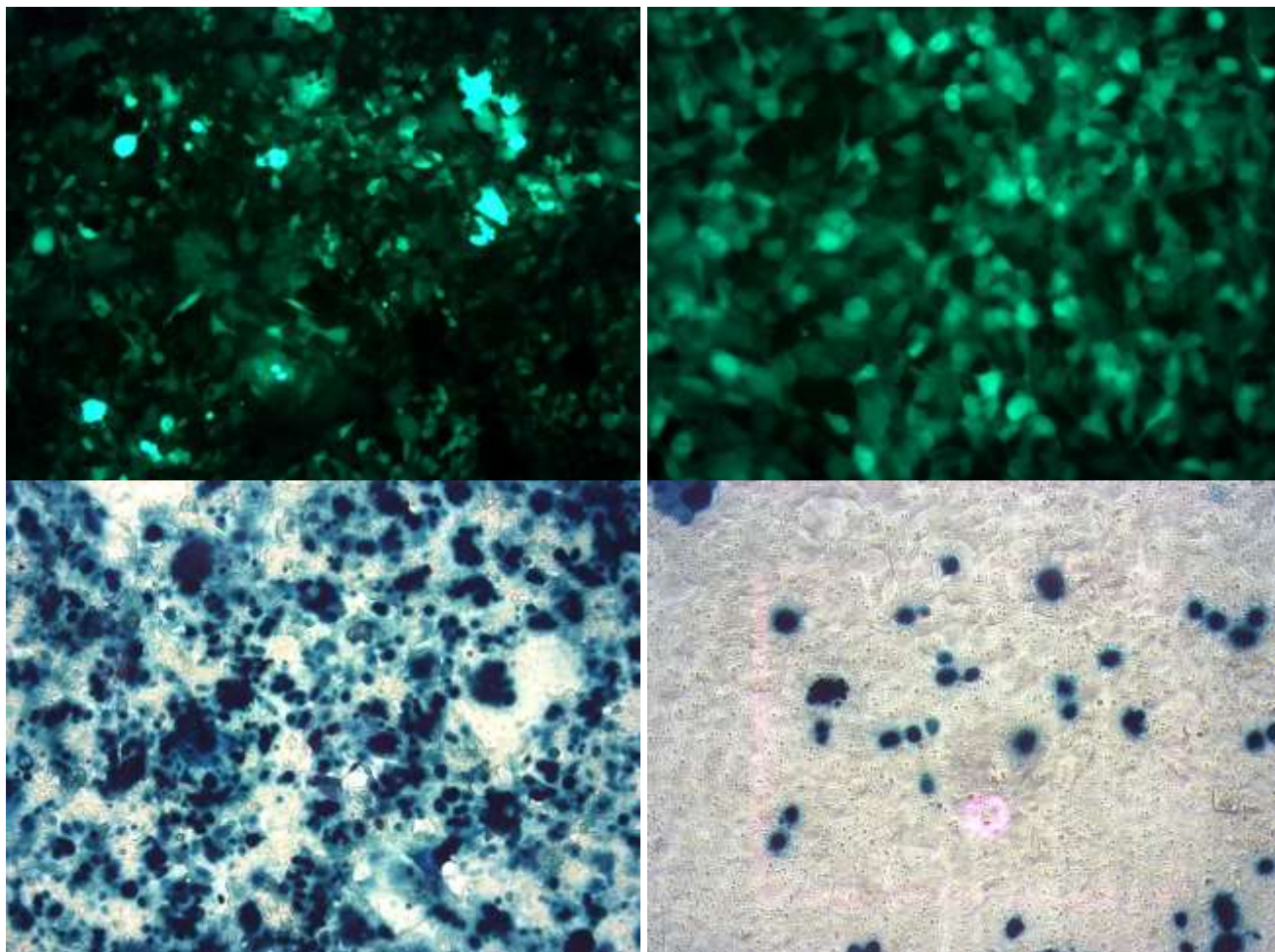


Figure 6: GFP and nLacZ Lentivirus Production and Transduction: Lentiviral supernatant is produced by cotransfecting 293T cells (Cat.# LTV-100) with pLenti-GFP (Cat.# LTV-400) or pSMPUW-MNDnLacZ (Cat.# LTV-402) and ViraSafe™ Lentiviral Packaging System (Cat. # VPK-206). 293AD cells (Cat.# AD-100) are seeded at 100,000 cells/well in a 6-well plate overnight. Cells were infected with GFP or nLacZ lentivirus in the presence of 8 $\mu\text{g}/\text{mL}$ Polybrene for 72 hrs. **Left:** 293LTV Transfection; **Right:** 293AD Transduction.

Appendix

pSMPUW-Puro Plasmid Sequence

- Pink:** 5' CMV/LTR, ψ , cPPT
- Blue:** EF-1
- Purple:** MCS
- Green:** PGK
- Red:** Puro
- Brown:** WPRE
- Orange:** 3' LTR
- Yellow:** Kanamycin Resistance gene

ACTAGTCGGGGTCATTAGTTCATAGCCATATATGGAGTTCGGCGTTACATAAECTACGGTAAATGGCCCGCTGGGTGACCGCCCAACGACCCCGCCATT
GACGTCAATAATGACGTATGTTCCCATAGTAACGCCAATAGGGACTTCCATTGACGTCAATGGGTGGAGTATTACGGTAAACTGCCCACTTGGCAGTACAT
CAAGTGTATCATATGCCAAGTACGCCCCCTATTGACGTCAATGACGGTAAATGGCCCGCTGGCATTATGCCAGTACACTTATGGGACTTTCCTACTT
GGCAGTACATCTACGTATTAGTCAATCGTATTACCATTGGTATGCGGTTTTGGCAGTACATCAATGGCCGTGGATAGCGGTTTACTCACGGGATTTCCAAG
TCTCCACCCCATTTGACGTCAATGGGAGTTGTTTTGGCACAAAATCAACGGGACTTCCAAAATGTCGTAACAACCTCCGCCCCATTGACGCAATGGCGGGT
AGGCGTGTACGGTGGGAGGTCATATAAGCAGAGCTGGTTTTAGTGAACCGGGTCTCTCTGGTTAGACCAGATTTGAGCCTGGGAGCTCTCTGGTAACTAGGG
AACCCACTGCTTAAGCCTCAATAAAGCTTGCCCTGAGTGCCTCAAGTAGTGTGTCGCCCTGTTGTTGTGACTCTGGTAACTAGAGATCCCTCAGACCCCTTTT
AGTCAGTGTGGAAAATCTCTAGCAGTGGCGCCCGAACAGGGACCTGAAAGCGAAAAGGGAAACCAGAGGAGCTCTCTCGACGAGGACTCGGCTTGGCTGAAGCG
CGCACGGCAAGAGCGAGGGCGGCGACTGCAGAGTACGCCAAAATTTGACTAGCGGAGGCTAGAAGGAGAGATGGGTGCGAGAGCGTCAATTAAGCG
GGGAAAATAGCGGCCGCCACAATTTAAAAGAAAAGGGGGGATTGGGGGTACAGTGCAGGGGAAAGAATAGTAGACATAATAGCAACAGACATACAAAATA
AAGAATTACAAAACAAATACAAAATTCAAATTTTCGGGGATCCGCTCCCGTCCACCCCGCCCGCCGACCGGAGCTGAGAGTAATTCAT
ACAAAAGGACTCGCCCTGCCTTGGGGAATCCAGGGACCGTCGTTAAACTCCCACTAACGTAGAACCCAGAGATCGCTGCGTTCGCCCCCTCACCCGCCC
GCTCTCGTCACTAGGTTGGAGAAGCATGCGTGGGCTCCGTTGCCGTGAGTGGGAGAGCGCACATCGCCACAGTCCCGAGAAGTTGGGGGGAGG
GGTCGGCAATGAACCGGTGCTAGAGAAGTGGCGGGGTAACCTGGGAAAGTATGTCGTGTACTGGCTCCGCTTTTTCCCGAGGGTGGGGGAGAACC
TATATAAGTGCAGTGTCCCGTGAACGTTCCGCGGCCAGATATCTCCCTTCGGACCAAGGGTCATTAATTAAGTACCGGGTAGGGAGCGCTTTCCCAA
GGCAGTCTGGGACATGCGCTTAGCAGCCCGCTGGGCACTGGCGCTACACAAGTGGCCCTCGGCTCGCACACATTCACATCCACGGGTAGGCGCCAAACC
GGCTCCGTTCTTTGGTGGCCCTTCGCGCCACTTCTACTCTCCCTAGTCAGGAAGTTCACCCCGCCCGCAGCTCGCGTCTGTCAGGACGTGACAAATG
GAAGTAGCACGCTCTACTAGTCTCGTGCAGATGGACAGCACCGCTGAGCAATGGAAGCGGGTAGGCTTTGGGGCAGCGGCAATAGCAGCTTTGCTCCTTCG
CTTCTGGGCTCAGGGGCGGGGCGCCGAAGTCTCCGAGGCGCGGATTTCTGCACGCTTCAAAGCGCACGCTGCGCGCTGTTCTCCTCTTCCT
CATCTCCGGGCTTTTCGACTCTAGCACGCTTGAACAATATGTACACACCATGGTTACCGAGTACAAGCCACCGGTGCGCTCGCCACCCCGCAGCAGCTCC
CCAGGGCCGTACGCACCTCGCCCGCGGTTCCGCGACTACCCCGCCAGCGCCACACCGTCTGATCCGGACCGCCACATCGAGCGGGTACCGAGCTGCAAGA
ACTCTTCTCAGCGCGGTGCGGCTCGACATCGGCAAGGTGTTGGGTGCGGGACGAGCGCGCGGTTGGCGGCTGAGCACGCGCGGAGAGCGTCAAGCGGGG
CGGCTGTTCCCGGAGATCGCCCGCAGTGGCCGAGTTGAGCGTTCCCGGCTGGCCCGCAGCAACAGATGGAAGGCCTCTGGCGCCGACCGGCCAAGG
AGCCCGCTTCCCTGGCCCGCTCGCCGCTCGCCGACCAAGGCAAGGCTGTTGGCGCTCGGCTCGCTGCTCCCGGAGTGGAGGGCCGAGCGCGC
CGGGGTGCCCCCTTCTGGAGACTCCGCGCCCGCAACCTCCCTTCTACGAGCGGCTCGGCTTACCCTCACCGCGCAGCTGAGGTGCCGAAGGACCG
CGACCTGGTGCATGACCCGCAAGCCCGGTGCTGAGTGCACAATCAACCTCTGGATTACAAAATTTGTGAAAGATTGACTGGTATTCTTAACATAGTTGCTC
CTTTACGCTATGTTGATACGCTGCTTAAATGCCTTTGTATCATGCTATTGCTTCCCGTATGGCTTTCATTTTCTCCTCCTGTATAAATCCTGGTTGCTGTC
TCTTTATCGAAGTGTGGCGTTGTGAGCAAGTGGCGTTCGCGCCGACCAAGGCAAGGCTGTTGGCTGACGCAACCCCACTGGTTGGGGCATTGCCACCACTGTGAG
CTCCTTTCCGGACTTTTCGCTTTCCCCCTCCCTATTGCCACGGCGAACTCATCGCCGCTGCCTTGCCTGCTGGACAGGGGCTCGGCTGTTGGGCACTG
ACAATCCCGTGGTGTGTCGGGAAATCATGTCCTTCTTGGCTGCTCGCTGTTGGCCACCTGGATTCTGCGCGGGACGTCCTTCTGCTACGTCCTCTC
GGCCCTCAATCCAGCGGACCTTCTTCCCGCGGCTGCTGCGGCTCTGCGGCTCTTCCCGCTTTCGCTTTCGCTTCCGCTCAGACGAGTCCGATCTCCCTTTGG
GCCCTCCCGCTTTAGTACTGGTACTTTAAGACCAATGACTTACAAGGCAAGTGTAGATCTTAGCCACTTTTTAAAAGAAAAGGGGGACTGGAAGGGCTA
ATTCACCTCCCAACGAAGACAAGATCCGGAATTTATTTGTGAAATTTGTGATGCTATTGCTTTATTTGTAAACCGGTGCAGCTGCTTTTTGCTGTACTGGGT
CTCTCTGGTTAGACCAGATCTGAGCCTGGGAGCTCTCTGGTAACTAGGGAACCCACTGCTTAAGCCTCAATAAAGCTTGCTTGAAGTGTCAAGTAGTGTG
TGCCCGTCTGTTGTGACTCTGGTAACTAGAGATCCCTCAGACCCCTTTAGTCAGTGTGGAAAATCTCTAGCATCTAGAGTATGCAAAGCATGCATCTCAAT
TAGTCAGCAACCAGGTGTGGAAAGTCCCAAGGCTCCCAAGCAGGCAAGATATGCAAAGCATGCATCTCAATAGTCAGCAACCATAGTCCCGCCCTAACTC
CGCCATCCCGCCCTAACTCCGCCAGTTCGCCCCATTCTCCGCCCATGGTACTAATTTTTTTTATTTATGTCAGAGGCGGAGGCGGCTCGGCTCTGA
GCTATTCAGAAAGTAGTGAGGAGGCTTTTTTGGAGGCTTAGGCTAGAGATCATAATCAGCCATACCACATTTGTAGAGGTTTACTTGTCTTAAAAAACCTCC
CACACCTCCCTGAACTGAAACATAAAATGAATGCAATTTGTTGTTAACTGTTTATTTGAGCTTATAATGGTTACAAAATAAAGCAATAGCATCACAAA
TTTACAAAATAAAGCATTTTTTTCACGTCATCTAGTTGTGGTTTTGTCCAAACATCAATCAATGATCTTATCATGTCTGCTAGCCGGGCTTTTTTTCTTAGGC
CTTCTCCGCTTCTCGTCACTGACTCGTGCCTCGGCTCGGCTGCGGCGAGCGGTATCAGCTCACTCAAAGGCGGTAATACGGTTATCCACAGAATC
AGGGGATAACGAGGAAAGAAATGTTGAGCAAAAGGCCAGCAAAAGGCCAGGAACCGTAAAAGGCCGCGTTGCTGGCGTTTTTCCATAGGCTCCGCCCCCT
GACGAGCATCACAAAATCGACGCTCAAGTCAAGGTTGGGCAAAACCCGACAGGACTATAAAGATACCAGGCGTTTTCCCTGGAAGCTCCCTCGTGCCTCTC
CTGTTCCGACCTGCGGCTTACCGGATACCTGTCCGCTTCTCCCTTCAGGCAAGCGTGGGCTTTCTCATAGCTCAGCGTGGGCTTTCTCATAGCTCAGCTGAGTATCAGT
GGTCTGCTCCTCAAGCTGGGCTGTGTGCACGAACCCCGGTTAGCCCGACCGCTGCGCCTTATCCGGTAACTATCGTCTTGTAGTCAACCCCGGTAAGACAC
GACTTATCGCCACTGCGAGGACCTGGTAAACAGGATTAGCAGAGCGAGGTATGTAGGCGGTGCTACAGAGTTCCTGAAGTGGTGGCCTAACTACGGCTACA
CTAGAAGAACAGTATTTGGTATCTGCGCTGCTGTAAGCCAGTTACCTTCGGAAAAAGAGTTGGTAGCTCTTGTATCCGGCAAAACAAACCAGCTGGTAGCGG
TGGTTTTTTTGTGTTGCAAGCAGCAGATTACGCGCAGAAAAAAGGATCTCAAGAAGATCTTTGATCTTTCTACGGGGTCTGACGCTCAGTGGAAACGAAAA

TCACGTTAAGGGATTTTGGTCATGAGATTATCAAAAAGGATCTTCACCTAGATCCCTTTAAATTA AAAATGAAGTTTTAAATCAATCTAAAGTATATATGAGT
AAACTTGGTCTGACAGTTACCAATGCTTAATCAGTGAGGCACCTATCTCAGCGATCTGTCTATTTTCGTTTCATCCATAGTTGCCTGACTCCTGCGCAGTCCAAA
AAAAAGGCTCCAAAAGGAGCCTTTAATTGTATCGGTGGGCCCTTAGAAAACTCATCGAGCATCAAATGAACTGCAATTTATTTCATATCAGGATTATCAAT
ACCATATTTTTGAAAAAGCCGTTTTCTGTAATGAAGGAGAAAACTCACCGAGGCAGTTCATAGGATGGCAAGATCCTGGTATCGGTCTGCGATTCCGACTCGT
CCAACATCAATACAACCTATTAAATTTCCCTCGTCAAAAAAAGGTTATCAAGTGAGAAATCACCATGAGTGACGACTGAATCCGGTGAGAATGGCAAAAGCT
TATGCATTTCTTTCCAGACTTGTTC AACAGGCCAGCCATTACGCTCGTCAAAAATCACTCGCATCAACCAACCCTTATTCATTCGTGATTGCGCCTGAGC
GAGACGAAATACGCGATCGCTGTTAAAAGGACAATTACAAACAGGAATCGAATGCAACCGGCGCAGGAACACTGCCAGCGCATCAACAATATTTTCACCTGAA
TCAGGATATTTCTTAATACCTGGAATGCTGTTTTCCCGGGGATCGCAGTGGTGAACCATGCATCATCAGGAGTACGGATAAAAATGCTTGATGGTCCGAA
GAGGCATAAATCCGTCAGCCAGTTTAGTCTGACCATCTCATCTGTAACATCATTTGGCAACGCTACCTTTGCCATGTTTCAGAAACAACCTCGGCGCATCGGG
CTTCCCATACAATCGATAGATTGTGCGCACCTGATTGCCCGACATTATCGCGAGCCCATTTATACCCATATAAATCAGCATCCATGTTGGAATTTAATCGCGGC
CTCGAGCAAGACGTTTTCCCGTTGAATATGGCTCAT AACACCCTTGTATTACTGTTTATGTAAGCAGACAGTTTTATTGTTTCATGATGATATATTTTATCTT
GTGCAATGTAACATCAGAGATTTTGGAGACACAACGTGGTTTTAAACA AATAGTCAAAAAGCCTCCGGCG

References

1. Chen, M. et al. (2002). *Nature Genetics* **32(4)**: 670-675.
2. Naldini, L., U. Blomer, P. Gally, D. Ory, R. Mulligan, F. H. Gage, I. M. Verma, and D. Trono (1996) *Science* **272**:263-267.
3. Verma, I. M., and N. Somia (1997) *Nature* **389**:239-242
4. Kahl C. A., Marsh J., Fyffe J., Sanders D. A., and K. Cornetta (2004) *J Virol.* **78**:1421-30.
5. White S. M., Renda M., Nam N. Y., Klimatcheva E., Zhu Y., Fisk J., Halterman M., Rimel B. J., Federoff H., Pandya S., Rosenblatt J. D., and V. Planelles (1999) *J Virol.* **73**:2832-40.
6. Kafri T., van Praag H., Ouyang L., Gage F. H., and I. M. Verma (1999) *J Virol.* **73**:576-84.

Notice to Purchaser

This product is sold for research and development purposes only and is not to be incorporated into products for resale without written permission from Cell Biolabs. The patented technology is covered by a license from CHLA and University of Southern California. By the use of this product you accept the terms and conditions of all applicable Limited Use Label Licenses. You may contact our Business Development department at busdev@cellbiolabs.com for information on sublicensing this technology.

Warranty

These products are warranted to perform as described in their labeling and in Cell Biolabs literature when used in accordance with their instructions. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THIS EXPRESSED WARRANTY AND CELL BIOLABS DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR PARTICULAR PURPOSE. CELL BIOLABS' sole obligation and purchaser's exclusive remedy for breach of this warranty shall be, at the option of CELL BIOLABS, to repair or replace the products. In no event shall CELL BIOLABS be liable for any proximate, incidental or consequential damages in connection with the products.

Contact Information

Cell Biolabs, Inc.
7758 Arjons Drive
San Diego, CA 92126
Worldwide: +1 858-271-6500
USA Toll-Free: 1-888-CBL-0505
E-mail: tech@cellbiolabs.com
www.cellbiolabs.com

©2009-2022: Cell Biolabs, Inc. - All rights reserved. No part of these works may be reproduced in any form without permissions in writing.