

## Altogen Biosystems

848 Rainbow Blvd Suite 823

Las Vegas, NV 89107 USA

Tel. (702) 349-6103

Fax. (702) 989-0841

E-mail: [techserv@altogen.com](mailto:techserv@altogen.com)

Web: [www.altogen.com](http://www.altogen.com)

### A549 CRISPR Transfection Kit (for Lung Carcinoma Cells, CCL-185)

**Catalog No. 2104**    Size: 1.5 ml

#### **Contents and Shipping:**

A549 CRISPR Transfection Kit includes A549 CRISPR Transfection Reagent (1.5 ml), Transfection Enhancer (0.5 ml), and Complex Condenser (0.5 ml). A549 CRISPR Transfection Reagent is supplied in liquid form at a concentration of 1 mg/ml, shipped at ambient temperature.

#### **Description:**

Proprietary formulation reagent optimized for CRISPR/Cas9 genetic modification procedures.

#### **A549 Cell Line Description:**

The A549 cell line has been used to investigate treatments for various forms of lung cancer. The A549 lung cancer cell line was derived in 1972 from the carcinomatous lung tissue of a 58-year-old male. A549 cells are human adenocarcinomic alveolar basal epithelial cells that are squamous and responsible for the diffusion of substances such as water and electrolytes, across the alveoli of lungs. This cell line a hypotriploid human cell line with the modal chromosome number of 66, occurring in 24 percent of cells. There were also frequent instances of cells with 64, 65, and 67 chromosome counts. A549 cells have been shown to synthesize lecithin with a high percentage of desaturated fatty acids via the cytidine diphosphocholine pathway. Immunoperoxidase staining shows that A549 cells are positive for keratin.

#### **Storage:**

Store reagent at 4°C upon receipt. If stored properly, reagent is stable for 6 months.

#### **Intended Use:**

For *in vitro* use only.

#### **Required materials (not included in the kit):**

- Cas9 NLS protein
- crRNA and tracrRNA (for manual sgRNA formation)
- sgRNA

\* Altogen Biosystems do not provide Cas9 protein, tracrRNA, or crRNA.

\*\*These components of CRISPR/Cas9 gene editing systems must be obtained separately.

#### **MSDS:**

MSDS documents are available online at [www.altogen.com](http://www.altogen.com)

#### **To Place an Order:**

Both domestic (USA) and international orders can be placed online ([www.altogen.com](http://www.altogen.com))

**Transfection Resource:** [www.altogen.com/transfection-resource](http://www.altogen.com/transfection-resource)

## **CRISPR/Cas9**

Clustered Regularly Interspersed Short Palindromic Repeats (CRISPR) refers to short, palindromic segments of viral DNA that are stored by bacteria. When a secondary viral infection occurs, a nuclease guided by RNA from the stored CRISPR locates and cleaves the viral DNA. The nuclease (Cas) is used for gene editing experiments by selecting the sequence that it targets. When double stranded DNA is cut, several repair mechanisms are initiated by the cell. The non-homologous end joining (NHEJ) pathway puts back together the cleaved DNA, which can result in gene knock out as a result of being cut off from the main strand. This may also result in frameshift mutations and accidental insertions of nearby DNA. The homology directed repair (HDR) pathway uses nearby strands of DNA that overlap the hanging ends to precisely repair the DNA. HDR can be used to introduce genes into DNA by flagging the desired introduced gene with segments that overlap the cleaved ends of cellular DNA, resulting in a segment known as a repair template.

### **Cas9 Functionality**

Cas9 is a DNA-binding nuclease that introduces nicks in double-stranded DNA. Before Cas9 can cut cellular DNA at a desired region, it must be paired with a guiding sequence of RNA used by the protein to locate the target region. This sequence of RNA (crRNA) must be designed and isolated for each specific gene-editing experiment. The crRNA isn't directly connected to the Cas9 protein though, rather the crRNA binds at one end to another sequence - tracrRNA, forming a hairpin structure to which the Cas9 protein binds. The tracrRNA is specific to the Cas9 protein, and must first anneal to the crRNA before being attached to Cas9. Together, the hybridized crRNA and tracrRNA are referred to as sgRNA (single-guide RNA). The sgRNA then binds to the Cas9 protein, forming a ribonucleoprotein (RNP) complex that enters the cell during transfection. The Cas9 protein cuts DNA locally three nucleotides upstream of a short sequence called the protospacer adjacent motif (PAM). The PAM sequence differs for different Cas proteins, but for Cas9 the PAM sequence is of the form NGG, where N can be any other nucleotide. This sequence is found fairly often in DNA, and the Cas9 protein will repeatedly bind to various PAM sites in search of a region matching the crRNA. Once a site that exactly matches the crRNA sequence is found, the Cas9 protein cleaves double-stranded DNA exactly three nucleotides upstream of the PAM sequence. For Eukaryotic cells, the Cas9 protein must have an added nuclear localization sequence (NLS) that will allow it to enter the nucleus of the cell, therefore Cas9 protein should have attached NLS.

### **Designing crRNA**

crRNA design include several important factors: length, specific segments, and overlap with tracrRNA. The Cas9 can only bind to a short crRNA sequence. The crRNA must have a 19-20 nucleotide region corresponding to the target DNA sequence of interest (20 nucleotides length is commonly used to target a specific region without any off-target effects).

crRNA must be designed to meet a few particular functions of the Cas9 protein:

- The segment of targeted cellular DNA with the crRNA sequence must have a PAM sequence.
- Cas9 protein will cleave the double-stranded cellular DNA three nucleotides upstream of the PAM sequence. Do not include the PAM sequence in the crRNA.

The crRNA must bind to the tracrRNA sequence before being coupled with the Cas9 protein. It is important to know what sequence the corresponding tracrRNA has, so crRNA is designed to have ~15nt overlap with the sequence. This overlap is necessary for proper formation of the RNP.

### **Gene Knockouts and Gene Insertions**

To knockout a target gene from a cell genome, two crRNA sequences should be designed that flag the desired gene on both sides. Combine the RNP's formed from both crRNA sequences when transfecting cells, as the DNA must be cleaved at both ends of the gene for NHEJ to knockout the targeted sequence. To insert a gene into a host cell genome, generate a repair template encoding construct of interest that will be delivered into target cells during transfection. When designing a repair template, it is important to ensure that it cannot be targeted by the RNP complex (with selected crRNA). The repair template should include the desired gene at the location where the Cas9 cleaves double stranded DNA to prevent further cleavage. Repair template should extend 40-60 base pairs on either side of the targeted cut site so that the HDR can incorporate it into the DNA during repair.

## CRISPR/Cas9 Transfection Protocol (for 24 well plate):

1. Culture A549 cells to around 70% confluence in complete growth medium.
2. Plate 10,000 - 15,000 A549 cells per well in 0.5 ml of serum-free growth medium 12–24 hours prior to transfection.
3. If you already have pre-formed sgRNA complexes, proceed to step 4, if you have crRNA and tracrRNA in separate solutions, proceed to step 3a.
  - a. Combine crRNA and tracrRNA in a 1:1 molar ratio.
  - b. Heat to 90°C.
  - c. Cool solution on ice for 30 minutes.
4. Mix sgRNA with Cas9 NLS protein in a 2:1 molar ratio.
5. Incubate RNP complexes for 30 minutes at room temperature.
6. Mix RNP complexes with A549 CRISPR transfection reagent. For Cas9 protein with an NLS sequence and attached sgRNA, combine 40 µl serum-free medium, 5.5 µl transfection reagent, and 750 ng of RNP complexes.
  - a. If using a repair template, add 50 ng during this step. The repair template must also be encapsulated to ensure high transfection efficiency.
  - b. If using higher amount of repair template, add higher amount of transfection reagent proportionally (1 µl for every 50 ng of DNA).
7. Incubate complexes for additional 30 minutes at room temperature.
8. Optional: add 2 µl of Complex Condenser to reduce the size of the encapsulated RNP complexes, however this may increase cell toxicity.
9. Add encapsulated RNP complexes to the 24 well plate with cultured cells. Test for target gene expression and or lack thereof in 36-72 hours.

\*Note that for Eukaryotic cells the efficiency is expected to be 10-15%.

## Scaling Up or Down Transfections:

Culture Vessel Surface Area (cm <sup>2</sup> )	Volume of Growth Medium (ml)	Transfection Reagent (µl)	Complex Condenser (µl)	Transfection Enhancer (µl)
96-well, 0.3 cm x cm	0.12	1.5	0.3	0.3
24-well, 2 cm x cm	0.5	5.5	2	2
12-well, 4 cm x cm	1	12	4	4
6-well, 10 cm x cm	3	35	12	12
60-mm, 20 cm x cm	5	60	20	20
10-cm, 60 cm x cm	15	180	60	60

## Optimizing Transfection:

To obtain the highest transfection efficiency, optimize transfection conditions by varying A549 cell density and amount of transfection reagent. High passage of A549 cells and use of antibiotics (or growth factors) may require using larger volumes of A549 transfection reagent per reaction.

## Limited Use Label License:

The purchase of this product conveys to the purchaser the limited right to use the purchased amount of the product only to perform internal research for the sole benefit of the purchaser. This product is for research purposes only and is not for use in commercial applications of any kind.

## Limited Product Warranty:

This warranty limits our liability to replacement of this product. No other warranties of any kind, express or implied, including, without limitation, implied warranties of merchantability or fitness for a particular purpose, are provided by Altogen Biosystems. Altogen Biosystems shall have no liability for any direct, indirect, consequential, or incidental damages arising out of the use, the results of use, or the inability to use this product. This product is developed, manufactured and sold for research purposes only. Reagent is not suitable for administration to humans.