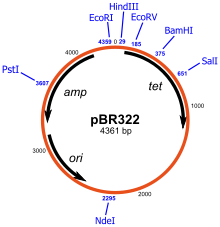
**Vectors**

In molecular cloning, a vector is a DNA molecule used as a vehicle to artificially carry foreign genetic material into another cell, where it can be replicated and/or expressed. A vector containing foreign DNA is termed recombinant DNA



What Do Vectors Have to Do With Genes and Cloning?

In molecular cloning, the vector is a DNA molecule that serves as the carrier for the transfer or insertion of foreign gene(s) into another cell, where it can be replicated and/or expressed. Vectors are among the [essential tools for gene cloning](https://www.thebalance.com/tools-for-protein-engineering-375522) and are most useful if they also encode some kind of marker gene encoding a bio indicator molecule that can be measured in a biological assessment to ensure their insertion, and expression, in the [host organism](https://www.thoughtco.com/bacteria-friend-or-foe-372431).

Specifically, a cloning vector is DNA taken from a virus, plasmid or cells (of higher organisms) to be inserted with a foreign DNA

fragment for cloning purposes. Since the cloning vector can be stably maintained in an organism, the vector also contains features that allow for the convenient insertion or removal of DNA. After being cloned into a cloning vector, the DNA fragment can be further sub-cloned into another vector that can be used with even more specificity.

In some cases, viruses are used to infect bacteria. These viruses are called bacteriophages, or phage, for short. Retroviruses are excellent vectors for introducing genes into animal cells. Plasmids, which are circular pieces of DNA, are the most commonly used vectors used to introduce foreign DNA into bacterial cells. They often carry antibiotic resistance genes that can be used to test for expression of the plasmid DNA, on antibiotic petri plates.

Gene transfer into plant cells is commonly performed using the soil bacterium *Agrobacterium tumefaciens*, which acts as a vector and inserts a large plasmid into the host cell. Only those cells containing the cloning vector will grow when antibiotics are present.

**The Major Types of Cloning Vectors**

The six major types of vectors are:

**1-Plasmid.**Circular extrachromosomal DNA that autonomously replicates inside the bacterial cell. [Plasmids](http://blog.addgene.org/plasmids-101-what-is-a-plasmid) generally have a high copy number, such as pUC19 which has a copy number of 500-700 copies per cell.

\***Plasmid vectors** are double-stranded, circular, self-replicating, extra-chromosomal DNA molecules.

Plasmids are circular DNA molecules present in the cytoplasm of the bacteria Capable of autonomous replication Can transfer

genes from one cell to other Act as vectors in genetic engineering. Can also present in Yeasts**. May encode genetic information for properties:**

1 Resitance to Antibiotics

2 Bacteriocins production

3 Enterotoxin production

4 Enhanced pathogen city

5 Reduced Sensitivity to mutagens

6 Degrade complex organic molecules

**Plasmid vector for cloning contain:**

1-Contains an origin of replication, allowing for replication independent of host’s genome.

2-Contains Selective markers: Selection of cells containing a plasmid

3-Contains a multiple cloning site (MCS)

***Advantages****:*

1-Small, easy to handle

2-Direct selection strategies

3-Useful for cloning small DNA fragments (< 10kbp)

4-Easy to be isolated from the host cell

***Disadvantages****:*

Less useful for cloning large DNA fragments

(> 10kbp)

**2-Phage**. Linear DNA molecules derived of bacteriophage lambda. Can be replaced with foreign DNA without disrupting its life cycle.(bacteriophage)

**Bacteriophage vectors**

***Advantages****:*

1-Useful for cloning large DNA fragments

(10 - 23 kbp)

2-Inherent size selection for large inserts

***Disadvantages****:*

Less easy to handle

**3-Cosmids.**Another circular extrachromosomal DNA molecule that combines features of plasmids and phage.

***Advantages:***

1-Useful for cloning very large DNA fragments

(32 - 47 kbp)

2-Inherent size selection for large inserts

3-Easy to Handle like plasmids

***Disadvantages****:*

Not easy to handle very large plasmids(~ 50 kbp)

**4-Bacterial Artificial Chromosomes BACs**. Based on bacterial mini-F plasmids.

**5-Yeast Artificial Chromosomes YACs**. This is an artificial chromosome that contains telomeres (disposable buffers at the ends of chromosomes which are cut off during cell division) with origins of replication, a yeast centromere (part of a chromosome that links sister chromatids or a dyad), and a selectable marker for identification in yeast cells.

\*BACs and YACs

*BACs* : Bacterial Artificial Chromosomes

*YACs* : Yeast Artificial Chromosomes

***Advantages:***

Useful for cloning extremely large DNA fragments

(100 - 2,000 kbp)

This is very important for genome sequencing projects

***Disadvantages****:*

Not easy to handle extremely large DNA molecules

**6-Human Artificial Chromosome**. This type of vector is potentially useful for gene delivery into human cells, and a tool for expression studies and determining human chromosome function. It can carry very large DNA fragment.

All engineered vectors have an origin of replication (a replicator), a cloning site (located where the insertion of foreign DNA neither

Disrupts replication or inactivation of essential markers), and a selectable marker (typically a gene that provides resistance to an antibiotic.)

**What determines the choice vector?**

1-insert site 2-vector size 3- restriction site 4-copy number

5- cloning efficiency 6-ability to screen for insert

