# Engineering Homework Help

Despite the existence of obvious obstacles and difficulties that sometimes stand in the way of development and implementation of genetic engineering products (GI), the XXI century can no longer be imagined without the fruit of this important and diverse technology in the arsenal of modern biologists. The most commonly used organism in GI are bacteria.

What is GI and why do we need it? Why are bacteria so popular among genetic engineers? In what form is the easiest to introduce the right gene into the bacteria? What kind of difficulties can be encountered when working with these organisms? What happened before: creating the first genetically engineered bacteria or discovering the structure of DNA and the genome? Read about this and much more under the catheter.

0. A brief biology education

This paragraph provides a brief description of the so-called Central Dogma of Molecular Biology. If you have a basic knowledge in molecular biology, then safely proceed to point 1.

The Central Dogma of Molecular Biology in one picture

Okay, here we go. All information about all stages of development and properties of any organism, whether prokaryotes (bacteria), archeae or eukaryotes (all other single and multicellular) is encoded in genomic DNA, which is a complex of two complementary polynucleotide chains forming a double helix (complementary DNA nucleotides: A-T and G-C). The eukaryote chromosomes are linear double-stranded DNA molecules, while the prokaryote chromosomes are ringed. Often, genes are only a small part of the entire genome (about 1.5% in humans).

Examples of DNA and RNA monomers. "Deoxy" in the DNA name means that there is no oxygen atom in position 2' (position 2' in figure is circled in red).

Two complementary chains of DNA to each other. Dotted lines show the hydrogen bonds between the bases. As can be seen, adenin and thymine form two hydrogen bonds between each other, while guanine and cytosine form three. Therefore, the G-C bond is stronger and the GC-rich areas of double-stranded DNA are more difficult to divide into two chains.

Note that each chain has a 5'-end and a 3'-end. You can see that around the 5'-end of the left chain is the 3'-end of the right chain and vice versa, so the chains are called "antiparallel". RNA also has a 5'-end and a 3'-end. The 5'- and 3'-end positions are chosen to denote the beginning and the end because it is through them that covalent bonds are formed in DNA and RNA chains.

DNA and RNA chains.

DNA and RNA sequences are always recorded from 5'-end to 3'-end. There are several reasons for this:

The synthesis of new DNA and RNA chains begins at the 5'-end (DNA polymerases (enzymes that synthesize the complementary DNA chain on a DNA or RNA matrix) and RNA polymerases (enzymes that synthesize the complementary RNA chain on a DNA or RNA matrix) go through the

matrix in the direction of 3' -> 5', so the new chain is synthesized in the direction of 5' -> 3');
The Ribosome reads the codons, moving along the mRNA in the direction of 5' -> 3';
The sequence of amino acids is written in the DNA coding chain in the 5' -> 3' direction (the significant part of mRNA is an exact copy of the section of the DNA coding chain with replacement of thymine by uracil and with the hydroxyl group (-OH) instead of hydrogen in the 2' position, of course);


Finally, it's just convenient to have a common recording rule.

A gene is a section of genomic DNA that defines the sequence of nucleotides in an RNA molecule:

Encoding RNA: a matrix RNA (mRNA) in which the amino acid sequence of the corresponding protein is encoded as codes. One can also find the name "information RNA", in which case the abbreviation looks like "IRNA";
non-coding RNA: transport RNA, ribosomal RNA and others.

The role of tRNA is to deliver amino acids to the mRNA-ribosome complex. In addition, it is tRNA that is responsible for the recognition of mRNA codes; for this purpose, each tRNA contains the so-called "anticodone" - triplet, the complementary codon of mRNA.