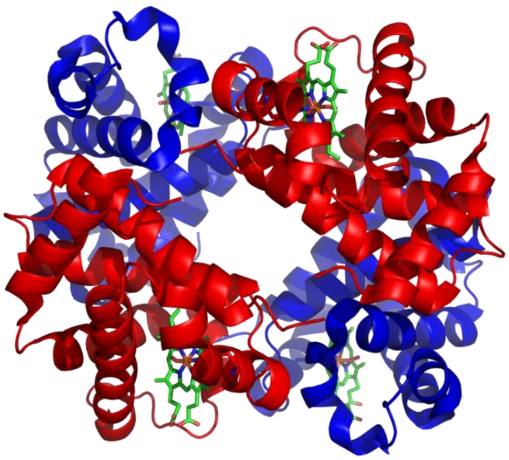
Video 4 - God's Integral Membrane Proteins versus Petrochemical DNA and RNA and Retrovirus mRNA (Scientific Lies being Exposed)



Hemoglobin

(heterotetramer, $(\alpha\beta)_2$)

Structure of human hemoglobin. α and β globin subunits are in red and blue, respectively, and the iron-containing heme groups in green. From PDB: 1GZX Proteopedia Hemoglobin

Protein type	metalloprotein, chromoprotein, globulin
Function	oxygen-transport
Cofactor(s)	heme (4)

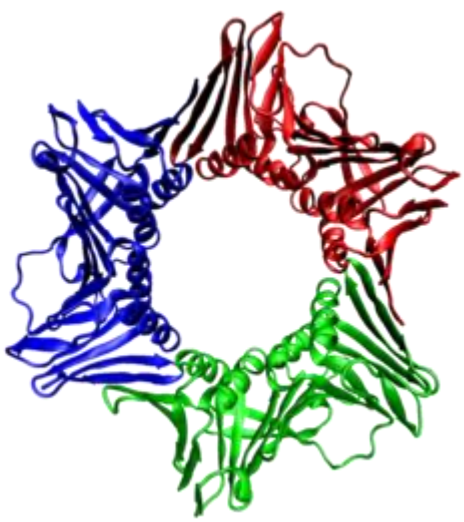
Subunit name	Gene	Chromosomal locus
Hb-α1	HBA1	Chr. 16 p13.3
Hb-α2	HBA2	Chr. 16 p13.3

Hb-β	HBB	Chr. 11 p15.5

https://en.wikipedia.org/wiki/Hemoglobulin

Humans, animals, and invertebrates have hemoglobulin, but GOD doesn't comprise any Red Blood cells. God comprises an elastic protein Iron, which we see in the Microtubules (Green annular formation), and this Iron supports the transportation of oxygen in red blood cells. (RBC)

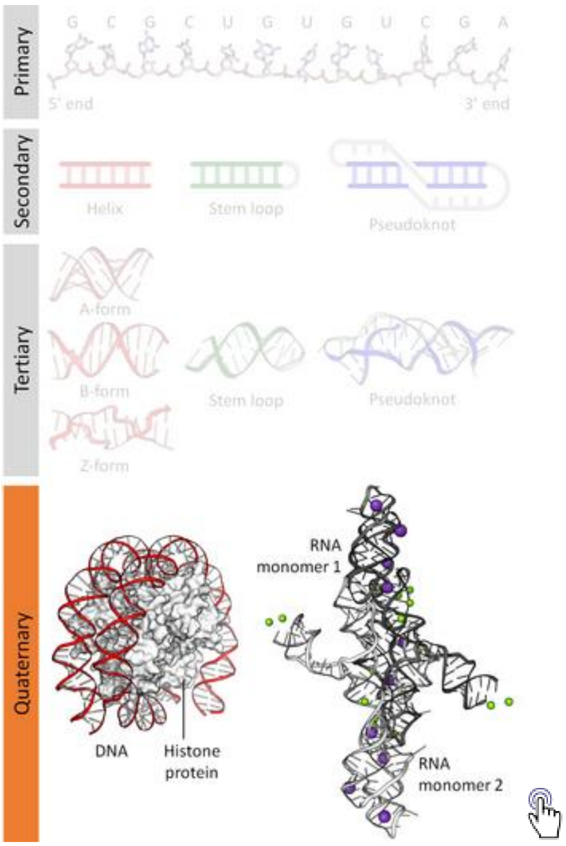
https://en.wikipedia.org/wiki/Protein_quaternary_structure



The quaternary structure of this protein complex would be described as a homo-trimer because it is composed of three identical smaller protein subunits (also designated as monomers or protomers).

https://en.wikipedia.org/wiki/Nucleic_acid_quaternary_structure

Nucleic acid quaternary structure



Interactive image of nucleic acid structure (primary, secondary, tertiary, and quaternary) using DNA helices and examples from the VS ribozyme and telomerase and nucleosome. (PDB: ADNA, 1BNA, 4OCB, 4R4V, 1YMO, 1EQZ)DNA coils and winds around histone proteins to condense into chromatin.

Nucleic acid quaternary structure refers to the interactions between separate nucleic acid molecules, or between nucleic acid molecules and proteins. The concept is analogous to protein quaternary structure, but as the analogy is not perfect, the term is used to refer to a number of different concepts in nucleic acids and is less commonly encountered.[1] Similarly other biomolecules such as proteins, nucleic acids have four levels of structural arrangement: primary, secondary, tertiary, and quaternary structure. Primary structure is the linear sequence of nucleotides, secondary structure involves small local folding motifs, and tertiary structure is the 3D folded shape of nucleic acid molecule. In general, quaternary structure refers to 3D interactions between multiple subunits. In the case of nucleic acids, quaternary structure refers to interactions between multiple nucleic acid molecules or between nucleic acids and proteins. Nucleic acid quaternary structure is important for understanding DNA, RNA, and gene expression because quaternary structure can impact function. For example, when DNA is packed into heterochromatin, therefore exhibiting a type of quaternary structure, gene transcription will be inhibited.

https://en.wikipedia.org/wiki/Globular_protein

In biochemistry, **globular proteins** or **spheroproteins** are spherical ("globe-like") proteins and are one of the common protein types (the others being fibrous, disordered and membrane proteins). Globular proteins are somewhat water-soluble (forming colloids in water), unlike the fibrous or membrane proteins.[1] There are multiple fold classes of globular proteins, since there are many different architectures that can fold into a roughly spherical shape.

The term globin can refer more specifically to proteins including the globin fold.[2]

Globular structure and solubility

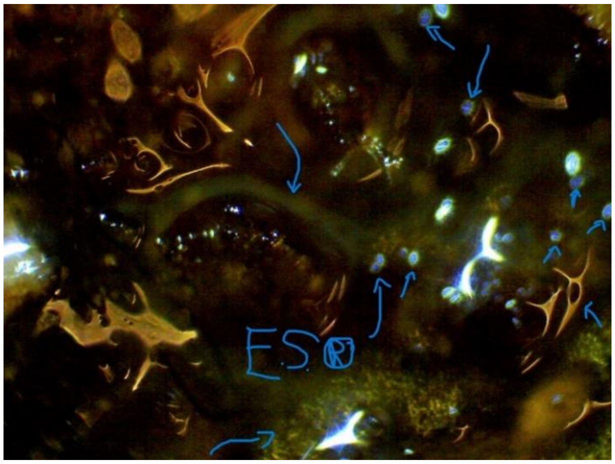
The term globular protein is quite old (dating probably from the 19th century) and is now somewhat archaic given the hundreds of thousands of proteins and more elegant and descriptive structural motif vocabulary. The globular nature of these proteins can be determined without the means of modern techniques, but only by using ultracentrifuges or dynamic light scattering techniques.

The spherical structure is induced by the protein's tertiary structure. The molecule's apolar (hydrophobic) amino acids are bounded towards the molecule's interior whereas polar (hydrophilic) amino acids are bound outwards, allowing dipole–dipole interactions with the solvent, which explains the molecule's solubility.

Globular proteins are only marginally stable because the free energy released when the protein folded into its native conformation is relatively small. This is because protein folding requires entropic cost. As a primary sequence of a polypeptide chain can form numerous conformations, native globular structure restricts its conformation to a few only. It results in a decrease in randomness, although non-covalent interactions such as hydrophobic interactions stabilize the structure.

Protein folding

Although it is still unknown how proteins fold up naturally, new evidence has helped advance understanding. Part of the protein folding problem is that several non-covalent, weak interactions are formed, such as hydrogen bonds and Van der Waals interactions. Via several techniques, the mechanism of protein folding is currently being studied. Even in the protein's denatured state, it can be folded into the correct structure.



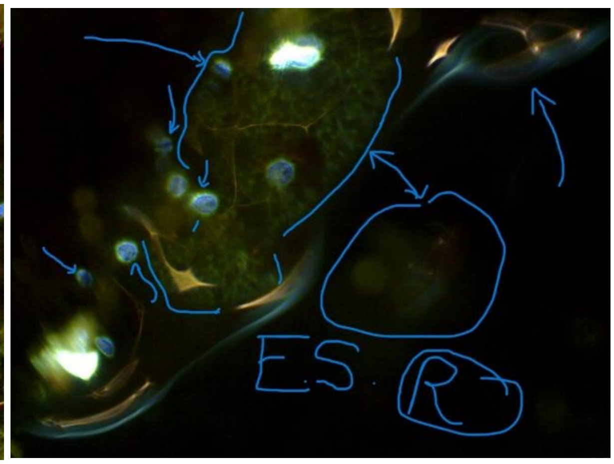


Image23-On the left…Gum resin- **40x magnification shows God's** copper gold collagen rich barbed end intermediate filaments or fibroblast and many Prismatic Genetic Centrosomes with Centriole Royal Purple nucleus-1.jpg [Upon expanding this image reveals Prismatic Genetic Centrosomes with Centriole Royal Purple nucleus showing mitotic cellular division and replication]

Image 26-On the Right…. Gum resin **40x magnification shows God's** copper collagen rich oblate microfilaments with extending lateral pointed ends-large spatial regions with Mitotic Green Tubules in various shapes some elliptical Centromeres with concentric rings-1.jpg [Note: blue arrows highlight formation of Green Microtubules behind the Prismatic Centrosomes]

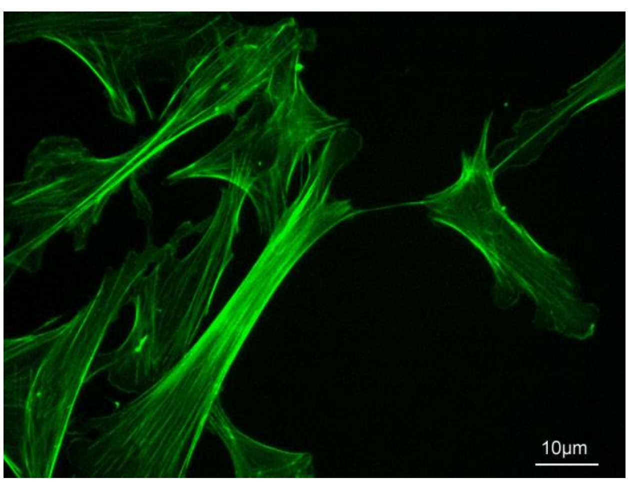


Image 28a shows a mouse embryo fibroblast

Image28a MEF_microfilaments- Microfilament (actin cytoskeleton) of mouse embryo fibroblasts, stained with FITC-phalloidin (100-fold magnification)- some resemblance to God's Intermediate Filaments .jpg

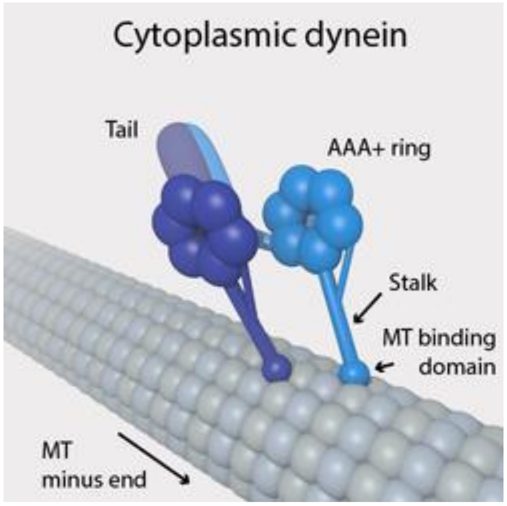
https://en.wikipedia.org/wiki/Microfilament

Microfilament (section Associated **proteins**)
actin-binding **proteins**, including **motor proteins**, branching **proteins**, severing **proteins**, polymerization promoters, and capping **proteins**.

Microfilaments (also known as **actin filaments**) are protein filaments in the cytoplasm of eukaryotic cells that form part of the cytoskeleton.[1] They are primarily composed of polymers of actin, but are modified by and interact with numerous other proteins in the cell. Microfilaments are usually about 7 nm in diameter and made up of two strands of actin.[1] Microfilament functions include cytokinesis, amoeboid movement, cell motility, changes in cell shape, endocytosis and exocytosis, cell contractility, and mechanical stability. Microfilaments are flexible and relatively strong, resisting buckling by multi-piconewton compressive forces and filament fracture by nanonewton tensile forces. In inducing cell motility, one end of the actin filament elongates while the other end contracts, presumably **by myosin II molecular motors**.

https://en.wikipedia.org/wiki/Myosin

Motor proteins are responsible for producing muscle contraction in muscle cells. Motor proteins are skeletal structural protein cells.



Cytoplasmic dynein on a microtubule
https://en.wikipedia.org/wiki/Dynein

Dyneins are a family of cytoskeletal motor proteins (though they are actually protein complexes) that move along microtubules in cells. They convert the chemical energy stored in ATP to mechanical work. Dynein transports various cellular cargos, provides forces and displacements important in mitosis, and drives the beat of eukaryotic cilia and flagella. All of these functions rely on dynein's ability to move towards the minus-end of the microtubules, known as retrograde transport; thus, they are called "minus-end directed motors". In contrast, most kinesin motor proteins move toward the microtubules' plus-end, in what is called anterograde transport.

Kinesin (category **Motor proteins**)
A kinesin is a **protein complex** belonging to a class of **motor proteins** found in eukaryotic cells. Kinesins move along microtubule (MT) filaments and are...
37 KB (4,290 words) - 02:07, 4 August 2025

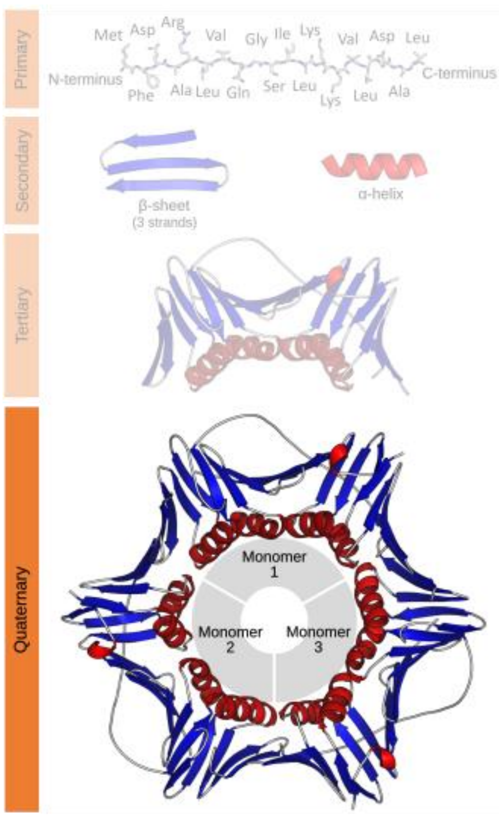
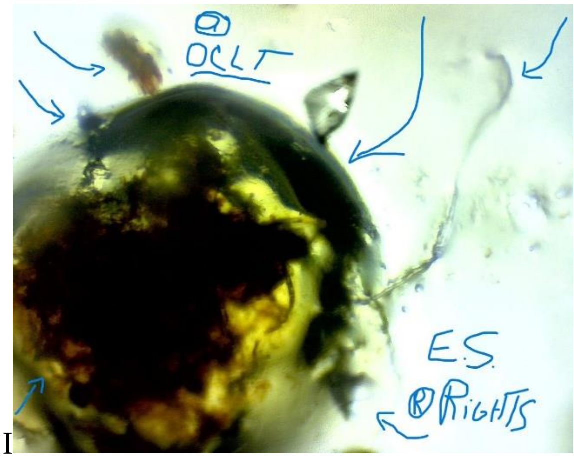


Image 5- Drawings of quaternary protein structures



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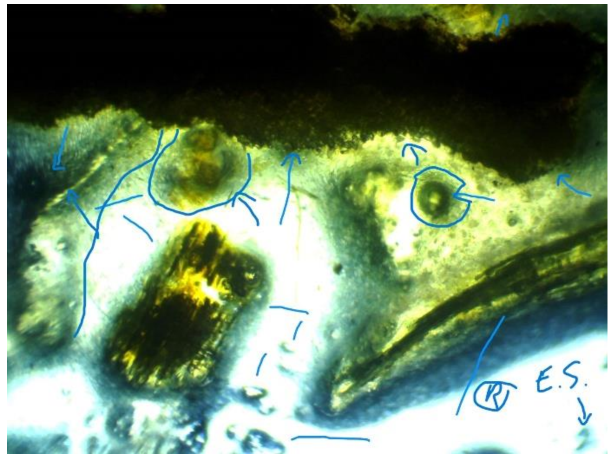


Image 7-40x magnification God's Plasma membrane **Image 4**- 400x magnification shows dark brown quaternary or annular chromatin protein structures of multi-units or linked organelles.

Image -7 at 40x magnification shows Evolutionary Spherical Primitive Plasma membrane (plasma blood) with neutron lipid (cholesterol and collagen) and chromatids or protein structures, and transparent dendrites and axons on top membrane surface (neurotransmitters) and mitochondria on the left side of top surface. Mitochondria and dendrites are involved in vesicular transport and neurotransmitter activity.

Image 4 400 x magnification shows Fibrous Microtubule Green Tracts on the left just below the compact quaternary structure of Chromatid/Protein annular structure, and on the right side shows Telophase in the last stage of mitosis and meiosis. Below the image of Telophase shows Golgi apparatus, and within the intracellular region of the Plasma membrane shows dark brown circular secretory vesicles.

This diagram (which is interactive) of protein structure uses PCNA as an example. (PDB: 1AXC)

https://en.wikipedia.org/wiki/Protein_structure

Structural domain

A structural domain is an element of the protein's overall structure that is self-stabilizing and often folds independently of the rest of the protein chain. Many domains are not unique to the protein products of one gene or one gene family but instead appear in a variety of proteins. **Domains often are named and singled out because they figure prominently in the biological function of the protein** they belong to; for example, the "calcium-binding domain of calmodulin". **Because they are independently stable, domains can be "swapped" by genetic engineering between one protein and another to make chimera proteins**. A conservative combination of several domains that occur in different proteins, such as protein tyrosine phosphatase domain and C2 domain pair, was called "a superdomain" that may evolve as a single unit.[10]

Scientific engineering (A gross manipulation of transfections via retroviruses or viral proteins.)

https://en.wikipedia.org/wiki/Fusion_protein

Fusion proteins or **chimeric** (kī-ˈmir-ik) **proteins** (literally, made of parts from different sources) are proteins created through the joining of two or more genes that originally coded for separate proteins. Translation of this *fusion gene* results in a single or multiple polypeptides with

A **recombinant fusion protein** is a protein created through genetic engineering of a fusion gene. This typically involves removing the stop codon from a cDNA sequence coding for the first protein, then appending the cDNA sequence of the second protein in frame through ligation or overlap extension PCR. That DNA sequence will then be expressed by a cell as a single protein. **The protein can be engineered to include the full sequence of both original proteins,** or only a portion of either.

https://en.wikipedia.org/wiki/Genetic_engineering

Genetic engineering, also called **genetic modification** or **genetic manipulation**, is the modification and manipulation of an organism's genes using technology. It is a set of technologies used to change the genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms. New DNA is obtained by either isolating and copying the genetic material of interest using recombinant DNA methods or by artificially synthesizing the DNA. A construct is usually created and used to insert this DNA into the host organism. The first recombinant DNA molecule was made by Paul Berg in 1972 by combining DNA from the monkey virus SV40 with the lambda virus. As well as inserting genes, the process can be used to remove, or "knock out", genes. The new DNA can either be inserted randomly or targeted to a specific part of the genome.[1]

An organism that is generated through genetic engineering is considered to be genetically modified (GM) and the resulting entity is a genetically modified organism (GMO). The first GMO was a bacterium generated by Herbert Boyer and Stanley Cohen in 1973 **Note: (This date has to be wrong because the scientist who worked for John Rockefeller started using retroviruses in 1889.)** They already knew about eukaryotes, prokaryotes, and archaea bacteria.)

Rudolf Jaenisch created the first GM animal when he inserted foreign DNA into a mouse in 1974. The first company to focus on genetic engineering, Genentech, was founded in 1976 and started the production of human proteins. Genetically engineered human insulin was produced in 1978 and insulin-producing bacteria were commercialized in 1982. Genetically modified food has been sold since 1994, with the release of the Flavr Savr tomato. The Flavr Savr was engineered to have a longer shelf life, but most current GM crops are modified to increase resistance to insects and herbicides. GloFish, the first GMO designed as a pet, was sold in the United States in December 2003. In 2016 salmon modified with a growth hormone were sold.

Genetic engineering has been applied in numerous fields including research, medicine, industrial biotechnology and agriculture. In research, GMOs are used to study gene function and expression through loss of function, gain of function, tracking, and expression experiments. By knocking out genes responsible for certain condition it is possible to create animal model organisms of human diseases.

There are multifunctional from large biopolymer

Proteins are enzymes that catalyze biochemical reactions and are vital to metabolism.

Proteins have structural or mechanical functions, such as actin and myosin in muscle, and the cytoskeleton's scaffolding proteins that maintain cell shape. Proteins are important in cell signaling, immune responses, cell adhesion, and the cell cycle.

The non-membrane bounded organelles, also called large biomolecular complexes, are large assemblies of macromolecules that carry out particular and specialized functions, but they lack membrane boundaries. Many of these are referred to as "proteinaceous organelles" as their main structure is made of proteins.[16] Such cell structures include:

large protein complexes: nucleosome centriole and microtubule-organizing center (MTOC)

- **Enzymes are generally globular proteins, acting alone or in larger complexes.**

The sequence of the amino acids specifies the structure which in turn determines the catalytic activity of the enzyme.[25] Although structure determines function, a novel enzymatic activity cannot yet be predicted from structure alone.
[26] Enzyme structures unfold (denature) when heated or exposed to chemical denaturants and this disruption to the structure typically causes a loss of activity.

https://en.wikipedia.org/wiki/Protein_complex
Protein complexes are a form of quaternary structure. Proteins in a protein complex are linked by non-covalent protein–protein interactions. These complexes are a cornerstone of many (if not most) biological processes. The cell is seen to be composed of modular supramolecular complexes, each of which performs an independent, discrete biological function.[2]

https://en.wikipedia.org/wiki/Membrane_protein

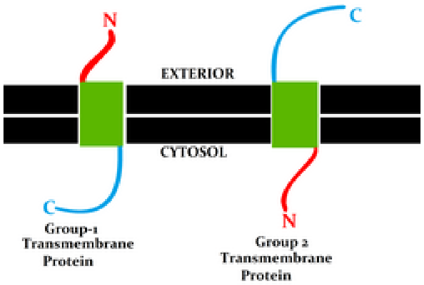
Some other integral membrane proteins are called monotopic, meaning that they are also permanently attached to the membrane, but do not pass through it.[3]

https://en.wikipedia.org/wiki/Integral_membrane_protein

An **integral**, or **intrinsic**, **membrane protein** (**IMP**) [1] **is a type of membrane protein that is permanently attached to the biological membrane.**
All transmembrane proteins can be classified as IMPs, but not all IMPs are transmembrane proteins.[2] IMPs comprise a significant fraction of the proteins encoded in an organism's genome.[3] Proteins that cross the membrane are surrounded by annular lipids, which are defined as lipids that are in direct contact with a membrane protein. Such proteins can only be separated from the membranes by using detergents, nonpolar solvents, or sometimes denaturing agents.

Proteins that adhere only temporarily to cellular membranes are known as peripheral membrane proteins. These proteins can either associate with integral membrane proteins or independently insert the lipid bilayer in several ways.

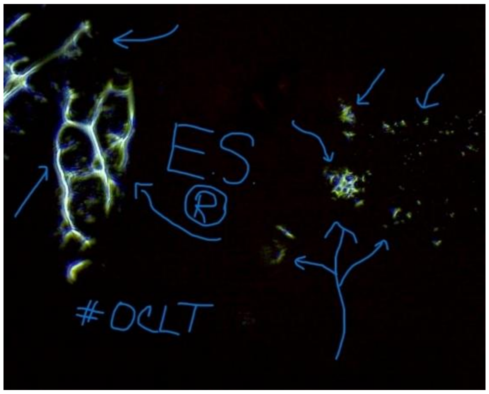
Structure



Group I and II transmembrane proteins have opposite orientations. Group I proteins have the N terminus on the far side and C terminus on the cytosolic side. Group II proteins have the C terminus on the far side and N terminus in the cytosol.

Three-dimensional structures of ~160 different integral membrane proteins have been determined at atomic resolution by X-ray crystallography or nuclear magnetic resonance spectroscopy. **They are challenging subjects for study owing to the difficulties associated with extraction and crystallization**. In addition, structures of many water-soluble protein domains of IMPs are available in the Protein Data Bank. Their membrane-anchoring α-helices have been removed to facilitate the extraction and crystallization. Search integral membrane proteins in the PDB (based on gene ontology classification)

The Difference between God's Integral membrane Proteins versus our DNA/RNA Nucleotide base pairs.



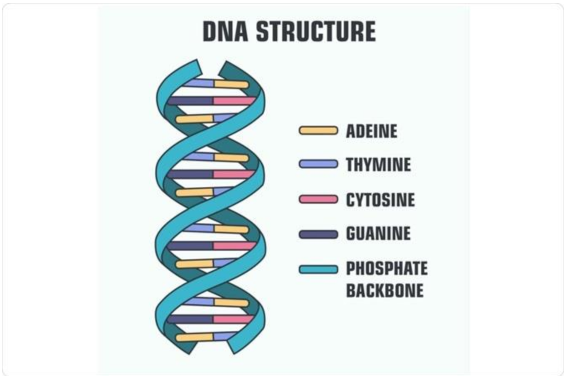


Image 30 **Image 31**

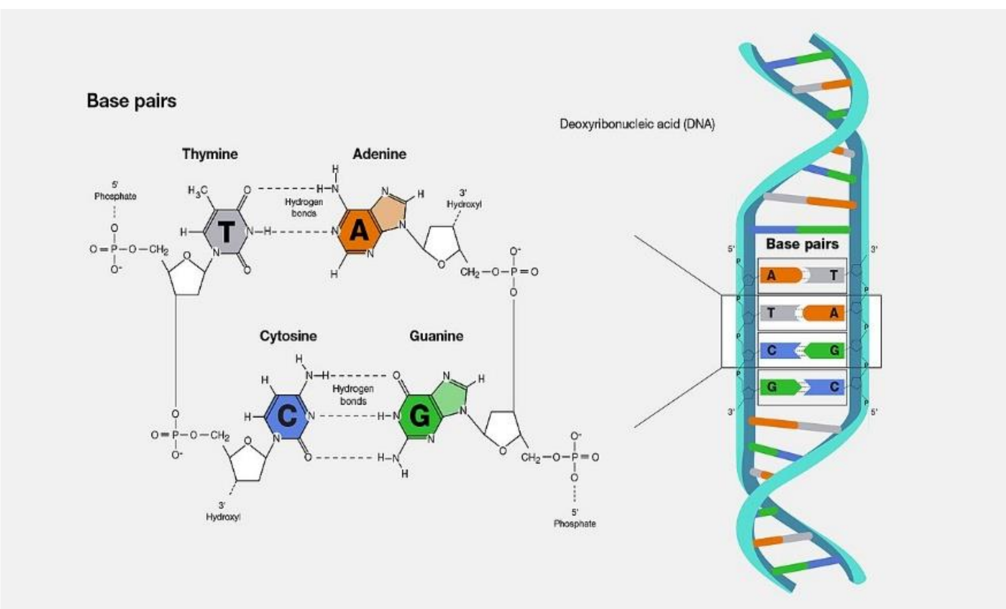
Image 30 can also be seen under the Navigation menu. Click on Resources go to Tree of Life Plasma Hydroglycerol page to see all micrographs.

Image 30 40x magnification shows God's fundamental unit of Double/Triple Integral membrane Proteins consists of neutral Calcium (blue), Iodine (Yellow), Magnesium (white), and an elastic essential Collagen/Cholesterol. No Synthetic Heterocyclic aromatic hydrocarbon Nucleotides of base-pair nucleic acids in God's primary or primitive cells, which we inherit from God.

Image 31 on the right schematic drawing of DNA/RNA with petrochemical base pairs of nucleobases.

Science manipulation using Petrochemicals and retroviruses to classify our DNA, RNA, and mRNA nucleic acids and retroviruses

A base pair (bp) is a fundamental unit of double-stranded nucleic acids consisting of two nucleobases bound to each other by hydrogen bonds. They form building blocks of DNA.



https://en.wikipedia.org/wiki/Base_pair

The chemical structure of DNA base-pairs

Darryl Leja for the National Human Genome Research Institute - https://genome.gov/genetics-glossary/Base-Pair

A diagram showing the structure of DNA base-pairs

https://en.wikipedia.org/wiki/Pyrimidine

Pyrimidine ($C_4H_4N_2$; /pɪˈrɪ.mɪˌdiːn, paɪˈrɪ.mɪˌdiːn/) is an aromatic, heterocyclic, organic compound similar to pyridine (C_5H_5N).[3] One of the three diazines (six-membered heterocyclics with two nitrogen atoms in the ring), it has nitrogen atoms at positions 1 and 3 in the ring.[4]:250 The other diazines are pyrazine (nitrogen atoms at the 1 and 4 positions) and pyridazine (nitrogen atoms at the 1 and 2 positions).

- In nucleic acids, three types of nucleobases are pyrimidine derivatives: cytosine (C), thymine (T), and uracil (U).

https://en.wikipedia.org/wiki/Purine

Purine is a heterocyclic aromatic organic compound that consists of two rings (pyrimidine and imidazole) fused together. It is water-soluble. Purine also gives its name to the wider class of molecules, **purines**, which include substituted purines and their tautomers. **They are the most widely occurring nitrogen-containing heterocycles in nature**.[1]

https://en.wikipedia.org/wiki/Base_pair

A **base pair** (**bp**) is a fundamental unit of double-stranded nucleic acids consisting of two nucleobases bound to each other by hydrogen bonds. They form the building blocks of the DNA double helix and contribute to the folded structure of both DNA and RNA. Dictated by specific hydrogen bonding patterns, "Watson–Crick" (or "Watson–Crick–Franklin") base pairs (guanine–cytosine and adenine–thymine/uracil)[1] allow the DNA helix to maintain a regular helical structure that is subtly dependent on its nucleotide sequence.[2] The complementary nature of this based-paired structure provides a redundant copy of the genetic information encoded within each strand of DNA. The regular structure and data redundancy provided by the DNA double helix make DNA well suited to the storage of genetic information, while base-pairing between DNA and incoming nucleotides provides the mechanism through which DNA polymerase replicates DNA and RNA polymerase transcribes DNA into RNA. Many DNA-binding proteins can recognize specific base-pairing patterns that identify particular regulatory regions of genes.

Intramolecular base pairs can occur within single-stranded nucleic acids. This is particularly important in RNA molecules (e.g., transfer RNA), where Watson–Crick base pairs (guanine–cytosine and adenine-uracil) permit the formation of short double-stranded helices, and a wide variety of non–Watson–Crick interactions (e.g., G–U or A–A) allow RNAs to fold into a vast range of specific three-dimensional structures. In addition, base-pairing between transfer RNA (tRNA) and messenger RNA (mRNA) forms the basis for the molecular recognition events that result in the nucleotide sequence of mRNA becoming translated into the amino acid sequence of proteins via the genetic code.

The size of an individual gene or an organism's entire genome is often measured in base pairs because DNA is usually double-stranded.

https://en.wikipedia.org/wiki/Ammonia

Ammonia is an inorganic chemical compound of nitrogen and hydrogen with the formula NH_3. A stable binary hydride and the simplest pnictogen hydride, ammonia is a colorless gas with a distinctive pungent smell.[13] It is widely used in fertilizers, refrigerants, explosives, cleaning agents, and is a precursor for numerous chemicals.[13] Biologically, it is a common nitrogenous waste, and it contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to fertilizers.[14] Around 70% of ammonia produced industrially is used to make fertilizers[15] in various forms and composition, such as urea and diammonium phosphate. Ammonia in pure form is also applied directly into the soil.

Ammonia, either directly or indirectly, is also a building block for the synthesis of many chemicals. In many countries, it is classified as an extremely hazardous substance.[16] Ammonia is toxic, causing damage to cells and tissues. For this reason, it is excreted by most animals in the urine, in the form of dissolved urea.

https://en.wikipedia.org/wiki/Guanine- a derivative of Purine (Nitrogen)

Guanine (/ˈɡwɑːniːn/ ⓘ) (symbol **G** or **Gua**) is one of the four main nucleotide bases found in the nucleic acids DNA and RNA, the others being adenine, cytosine, and thymine (uracil in RNA). In DNA, guanine is paired with cytosine. The guanine nucleoside is called guanosine.

With the formula $C_5H_5N_5O$, guanine is a derivative of purine, consisting of a fused pyrimidine-imidazole ring system with conjugated double bonds. This unsaturated arrangement means the bicyclic molecule is planar.

With the formula $C_5H_5N_5O$, guanine is a derivative of purine, consisting of a fused pyrimidine-imidazole ring system with conjugated double bonds. This unsaturated arrangement means the bicyclic molecule is planar.

https://en.wikipedia.org/wiki/Uracil

Laboratory

There are many laboratory synthesis of uracil available. The first reaction is the simplest of the syntheses, by adding water to cytosine to produce uracil and ammonia:[2]

$$C_4H_5N_3O + H_2O \rightarrow C_4H_4N_2O_2 + NH_3$$

The most common way to synthesize uracil is by the condensation of malic acid with urea in fuming sulfuric acid:[5]

$$C_4H_4O_4 + NH_2CONH_2 \rightarrow C_4H_4N_2O_2 + 2\ H_2O + CO$$

Uracil can also be synthesized by a double decomposition of thiouracil in aqueous chloroacetic acid.[5]

Photodehydrogenation of 5,6-diuracil, which is synthesized by beta-alanine reacting with urea, produces uracil.[17]

https://en.wikipedia.org/wiki/2-Thiouracil

2-Thiouracil is a chemical derivative of uracil in which the oxygen atom in the 2-position of the ring is substituted by sulfur.

The substance is a historically relevant anti-thyroid preparation. Edwin Astwood used it in 1943 as therapy for Graves' disease for the first time.[1][2][3]

Thiouracil inhibits thyroid activity by blocking the enzyme thyroid peroxidase.[4] Its use in recent times has been replaced by advent of more potent and safer antithyroid drugs.

https://en.wikipedia.org/wiki/Cytosine

Biological function

When found third in a codon of RNA, cytosine is synonymous with uracil, as they are interchangeable as the third base. When found as the second base in a codon, the third is always interchangeable. For example, UCU, UCC, UCA and UCG are all serine, regardless of the third base.

Active enzymatic deamination of cytosine or 5-methylcytosine by the APOBEC family of cytosine deaminases could have both beneficial and detrimental implications on various cellular processes as well as on organismal evolution.[9] The implications of deamination on 5-hydroxymethylcytosine, on the other hand, remain less understood.

https://www.news-medical.net/health/What-is-Thymine.aspx

Albrecht Kossel and Albert Neumann discovered thymine in 1893 when they successfully isolated thymine from the thymus glands of calves for the first time in history. **Today Thymine** also known **as 5 methyl uracil**, is derived from **Benzene methylation ring or methoxybenzene.**

https://en.wikipedia.org/wiki/Methanol

Methanol (also called **methyl alcohol** and **wood spirit**, amongst other names) is an organic **chemical compound and the simplest aliphatic alcohol, with the chemical formula CH_3OH (a methyl group linked to a hydroxyl group**, often abbreviated as **MeOH**). It is a light, volatile, colorless and flammable liquid with a distinctive alcoholic odor similar to that of ethanol (potable alcohol), but is more acutely toxic than the latter.[17] Methanol acquired the name **wood alcohol** because it was once produced through destructive distillation of wood. Today, methanol is mainly produced industrially by hydrogenation of carbon monoxide.[18]

Methanol consists of a methyl group linked to a polar hydroxyl group. With more than 20 million tons produced annually, it is used as a precursor to other commodity chemicals, including formaldehyde, acetic acid, methyl *tert*-butyl ether, methyl benzoate, anisole, peroxyacids, as well as a host of more specialized chemicals.[18]

Chemical structure

The chemical structure of thymine includes the ring-shaped pyrimidine molecule, which is a similarity shared by each of the nucleobases.

During the formation of DNA, thymine and adenine are always paired together by the force of two hydrogen bonds, which creates a stable nucleic acid structure. In a comparable fashion, **guanine and cytosine bind together during the generation of DNA**. Under specific conditions, such as exposure to ultraviolet light, thymine dimers may also occur, although this is much less common than the thymine-adenine pairing. In most cases, thymine is not present in ribonucleic acid (RNA) structures, as it is replaced by uracil.

The scientific name of thymine, 5-methyluracil, implies that it can be derived through the methylation of uracil at the position of the 5th carbon. Specifically, in the chemical structure, this **means that a methyl (-CH3)** branch is added to the pyrimidine ring.

Phosphorylation

When combined with deoxyribose, thymine forms the nucleoside deoxythymidine, which is more commonly known as thymidine.

Thymidine can undergo phosphorylation, during which phosphoric acid groups are added to this substance to form thymidine monophosphate, thymidine diphosphate, or thymidine triphosphate, depending on the number of phosphoric acid groups added.

Thymine in space

In 2015, NASA scientists reported evidence that thymine could successfully be produced in laboratory conditions that resembled outer space.

Meteorites often contain chemical substances such as pyrimidine polycyclic aromatic hydrocarbons; therefore, this observation was used as a starting base in the laboratory. Under simulated conditions, the scientists were able to produce thymine, uracil, and cytosine. As these nucleobases play a considerable role in the building blocks of life, their successful formation under space-like conditions raised important questions as to whether some forms of life could be supported in outer space. **To date, this is purely theoretical**

Prebiotic

In 2009, NASA scientists reported having produced uracil from pyrimidine and water ice by exposing it to ultraviolet light under space-like conditions.[10] This suggests a possible natural original source for uracil.[18] In 2014, NASA scientists reported that additional complex DNA and RNA organic compounds of life, including uracil, cytosine and thymine, have been formed in the laboratory under outer space conditions, starting with ice, pyrimidine, ammonia, and methanol, which are compounds found in astrophysical environments.[19] **Pyrimidine, like polycyclic aromatic hydrocarbons (PAHs), a carbon-rich chemical** found in the Universe, may have been formed in red giants or in interstellar dust and gas clouds.[20]

References

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https://en.wikipedia.org/wiki/Adenine

Adenine (/ˈædɪniːn/, /ˈædɪnɪn/) (symbol **A** or **Ade**) is a purine nucleotide base that is found in DNA, RNA, and ATP.[2] Usually a white crystalline subtance.[2] The shape of adenine is complementary and pairs to either thymine in DNA or uracil in RNA.

Biosynthesis

Purine metabolism involves the formation of adenine and guanine. Both adenine and guanine are derived from the nucleotide inosine monophosphate (IMP), which in turn is synthesized from a pre-existing ribose phosphate through a complex pathway using atoms from the amino acids glycine, glutamine, and aspartic acid, as well as the coenzyme tetrahydrofolate.

Patented August 20, 1968, the current recognized method of industrial-scale production of adenine involves heating formamide under 120 °C.[6]

Adenine is one of the two purine nucleobases (the other being **guanine**) used in forming nucleotides of the nucleic acids. In DNA, adenine binds to thymine via two hydrogen bonds to assist in stabilizing the nucleic acid structures. In RNA, which is used for protein synthesis, adenine binds to uracil.

https://en.wikipedia.org/wiki/Phosphate

Phosphates are the naturally occurring form of the element phosphorus.[2]

In chemistry, a **phosphate** is an anion, salt, functional group or ester **derived from a phosphoric acid**. It most commonly means **orthophosphate**, a derivative of orthophosphoric acid, a.k.a. phosphoric acid H_3PO_4.

https://en.wikipedia.org/wiki/Simple_aromatic_ring

Simple aromatic rings, also known as **simple arenes** or **simple aromatics**, are aromatic organic compounds that consist only of a conjugated planar ring system.[*citation needed*] Many simple aromatic rings have trivial names. They are usually found as substructures of more complex molecules ("substituted aromatics"). **Typical simple aromatic compounds are benzene, indole, and pyridine.[1]**

Simple aromatic rings can be heterocyclic if they contain non-carbon ring atoms, for example, **oxygen, nitrogen, or sulfur**. They can be **monocyclic as in benzene**, **bicyclic as in naphthalene**, or **polycyclic as in anthracene**. Simple monocyclic aromatic rings are usually five-membered rings like pyrrole or six-membered rings like pyridine. Fused bicyclic molecules consist of two rings that are connected by shared edges.[*clarification needed*]

https://en.wikipedia.org/wiki/Polycyclic_aromatic_hydrocarbon

Properties

Physicochemical

PAHs are nonpolar and lipophilic. Larger PAHs are generally insoluble in water, although some smaller PAHs are soluble.[23][24] The larger members are also poorly soluble in organic solvents and in lipids. The larger members, e.g. perylene, are strongly colored.[18]

Half-cell potential of aromatic compounds against the SCE ($Fc^{+/0}$)[26]	
Compound	**Potential (V)**
benzene	−3.42
biphenyl[27]	−2.60 (-3.18)
naphthalene	−2.51 (-3.1)
anthracene	−1.96 (-2.5)
phenanthrene	−2.46
perylene	−1.67 (-2.2)
pentacene	−1.35

Redox

Polycyclic aromatic compounds characteristically yield radicals and anions upon treatment with alkali metals. The large PAH form dianions as well.[25] The redox potential correlates with the size of the PAH.

https://en.wikipedia.org/wiki/Benzene

Benzene is an organic chemical compound with the molecular formula C_6H_6. The benzene molecule is composed of six carbon atoms joined in a planar hexagonal ring with one hydrogen atom attached to each. Because it contains only carbon and hydrogen atoms, benzene is classed as a hydrocarbon.

Benzene is a natural constituent of petroleum and is one of the elementary petrochemicals. Due to the cyclic continuous pi bonds between the carbon atoms and satisfying Hückel's rule, benzene is classed as an aromatic hydrocarbon. Benzene is a colorless and highly flammable liquid with a sweet smell, and is partially responsible for the aroma of gasoline. It is used primarily as a precursor to the manufacture of chemicals with more complex structures, such as ethylbenzene and cumene, of which billions of kilograms are produced annually. **Although benzene is a major industrial chemical, it finds limited use in consumer items because of its toxicity**. Benzene is a volatile organic compound.[14]

Benzene is classified as a carcinogen. Its particular effects on human health, such as the long-term results of accidental exposure, have been reported on by news organizations such as *The New York Times*. For instance, a 2022 article stated that benzene contamination in the Boston metropolitan area caused hazardous conditions in multiple places, with the publication noting that the compound may eventually cause leukemia in some individuals.[15]

https://en.wikipedia.org/wiki/Imidazole

Imidazole (ImH) is an organic compound with the formula $(CH)_3(NH)N$. It is a white or colorless solid that is soluble in water, producing a mildly alkaline solution. **It can be classified as a heterocycle, specifically as a diazole.**

When fused to a pyrimidine ring, it forms a purine, which is the most widely occurring nitrogen-containing heterocycle in nature.[10]

The name "imidazole" was coined in 1887 by the German chemist Arthur Rudolf Hantzsch (1857–1935).[11]

Related heterocycles

- **Benzimidazole, an analog with a fused benzene ring**
- Dihydroimidazole or imidazoline, an analog where the 4,5-double bond is saturated
- Pyrrole, an analog with only one nitrogen atom in position 1
- Oxazole, an analog with the nitrogen atom in position 1 replaced by oxygen

- Thiazole, an analog with the nitrogen atom in position 1 replaced by sulfur
- Pyrazole, an analog with two adjacent nitrogen atoms
- Triazoles, analogs with three nitrogen atoms

Safety

Imidazole has low acute toxicity as indicated by the LD_{50} of 970 mg/kg (Rat, oral).[24]

https://en.wikipedia.org/wiki/Transfection

Transfection and Transduction

From Wikipedia, the free encyclopedia

Transfection is the process of deliberately introducing naked or purified nucleic acids into eukaryotic cells.[1][2] It may also refer to other methods and cell types, although other terms are often preferred: "transformation" is typically used to describe non-viral DNA transfer in bacteria and non-animal eukaryotic cells, including plant cells.

In animal cells, transfection is the preferred term as transformation is also used to refer to progression to a cancerous state (carcinogenesis) in these cells. **Transduction is often used to describe virus-mediated gene transfer into eukaryotic cells.[2][3]**

The word *transfection* is a portmanteau of *trans*- and *infection*. Genetic material (such as supercoiled plasmid DNA or siRNA constructs), may be transfected. Transfection of animal cells typically involves opening transient pores or "holes" in the cell membrane to allow the uptake of material. Transfection can be carried out using calcium phosphate (i.e.

tricalcium phosphate), by electroporation, by cell squeezing, or by mixing a cationic lipid with the material to produce liposomes that fuse with the cell membrane and deposit their cargo inside.

Transfection can result in unexpected morphologies and abnormalities in target cells.

Terminology

The meaning of the term has evolved.[4] The original meaning of transfection was "infection by transformation", i.e., introduction of genetic material, DNA or RNA, from a prokaryote-infecting virus or bacteriophage into cells, resulting in an infection. For work with bacterial and archaeal cells transfection retains its original meaning as a special case of transformation. Because the term transformation had another sense in animal cell biology (a genetic change allowing long-term propagation in culture, or acquisition of properties typical of cancer cells), the term transfection acquired, for animal cells, its present meaning of a change in cell properties caused by introduction of DNA.[*citation needed*]

Methods

There are various methods of introducing foreign DNA into a eukaryotic cell: some rely on physical treatment (electroporation, cell squeezing, nanoparticles, magnetofection); others rely on chemical materials or biological particles (viruses) that are used as carriers. There are many different methods of gene delivery developed for various types of cells and tissues, from bacterial to mammalian. Generally, the methods can be divided into three categories: physical, chemical, and biological.[5]

Physical methods include electroporation, microinjection, gene gun, impalefection, hydrostatic pressure, continuous infusion, and sonication. Chemicals include methods such as lipofection, which is a lipid-mediated DNA-transfection process utilizing liposome vectors. It can also include the use of polymeric gene carriers (polyplexes).[6] **Biological transfection is typically mediated by viruses, utilizing the ability of a virus to inject its DNA inside a host cell**. A gene that is intended for delivery is packaged into a replication-deficient viral particle. Viruses used to date include retrovirus, lentivirus, adenovirus, adeno-associated virus, and herpes simplex virus.[*citation needed*]

Physical methods

Electroporator with square wave and exponential decay waveforms for in vitro, in vivo, adherent cell and 96 well electroporation applications. Manufactured by BTX Harvard Apparatus, Holliston MA USA.

Physical methods are the conceptually simplest, using some physical means to force the transfected material into the target cell's nucleus. The most widely used physical method is electroporation, where short electrical pulses disrupt the cell membrane, allowing the transfected nucleic acids to enter the cell.[5] Other physical methods use different means to poke holes in the cell membrane: Sonoporation uses high-intensity ultrasound (attributed mainly to the cavitation of gas bubbles interacting with nearby cell membranes), optical transfection uses a highly focused laser to form a ~1 µm diameter hole.[7]

Several methods use tools that force the nucleic acid into the cell, namely: microinjection of nucleic acid with a fine needle;[5] biolistic particle delivery, in which nucleic acid is attached to heavy metal particles (usually gold) and propelled into the cells at high speed;[8] and magnetofection, where nucleic acids are attached to magnetic iron oxide particles and driven into the target cells by magnets.[8]

Hydrodynamic delivery is a method used in mice and rats, in which nucleic acids can be delivered to the liver by injecting a relatively large volume in the blood in less than 10 seconds; nearly all of the DNA is expressed in the liver by this procedure.[9]

Viral methods

DNA can also be introduced into cells using viruses as a carrier. In such cases, the technique is called transduction, and the cells are said to be transduced. **Adenoviral vectors can be useful for viral transfection methods because they can transfer genes into a wide variety of human cells and have high transfer rates**.[2] Lentiviral vectors are also helpful due to their ability to transduce cells not currently undergoing mitosis.

Protoplast fusion is a technique in which transformed bacterial cells are treated with lysozyme in order to remove the cell wall. Following this, Fuso genic agents (e.g., Sendai virus, PEG, electroporation) are used in order to fuse the protoplast carrying the gene of interest with the target recipient cell. A major disadvantage of this method is that bacterial components are non-specifically introduced into the target cell as well.