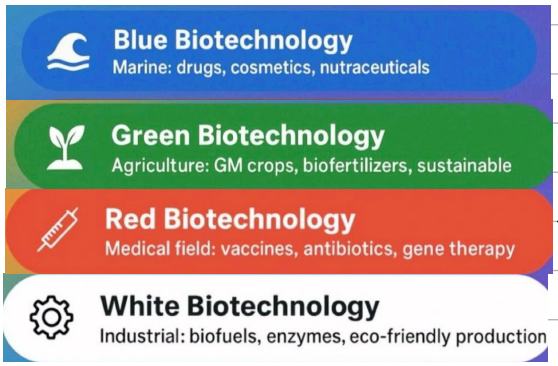
Biotechnology

التقنيات الحيوية

1-Colors of biotechnology



⇐ ركز عليه

2-Forensic Evidence and Genetic Profiles

Short tandem repeats, or STRs, are short DNA sequences made of 2–6 base pairs that are repeated many times in a row at specific locations in the genome.

- The number of repeats varies from person to person, which makes STRs highly useful as genetic markers.
- PCR and gel electrophoresis are used to amplify and then identify STRs of different lengths
- The probability that two people who are not identical have the same STR markers is rare.

التكرارات القصيرة المتتالية (Short Tandem Repeats - STRs) هي سلاسل DNA قصيرة مكونة من 2–6 قواعد نيتروجينية تكرر في مواقع محددة في الجينوم.
عدد مرات التكرار يختلف بين الأفراد، مما يجعل التكرارات القصيرة المتتالية علامات جينية مفيدة.
يتم تحليلها باستخدام تقنية(PCR) و (gel electrophoresis).
وفرصة أن يشترك شخصان غير متطابقين في نفس الملف الوراثي للتكرارات القصيرة المتتالية منخفضة جدًا.

3-Story

أطلق سراحه في 2001 بعد إثبات براءته باستخدام DNA إيرل واشنطن قضى 17 سنة في السجن بعد إدانته زورًا بجريمة قتل.

Source of sample	STR marker 1	STR marker 2	STR marker 3
Semen on victim	17, 19	13, 16	12, 12
Earl Washington	16, 18	14, 15	11, 12
Kenneth Tinsley	17, 19	13, 16	12, 12

(b) These and other STR data exonerated Washington and led Tinsley to plead guilty to the murder.

بس قصة توضيحية
لأهمية هذا العلم كيف كشفت جريمة وبينت براءة شخص باستخدام STR

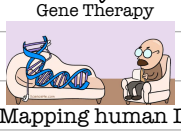
This photo shows Earl Washington just before his release in 2001, after 17 years in prison.

Applications of Medical Biotechnology

Pharmacology & Drug Development

Utilizing recombinant DNA technology to produce therapeutic proteins, insulin, growth hormones, and clotting factors.

Gene Therapy



Mapping human DNA to identify genetic bases for diseases and utilizing techniques to repair or replace faulty genes.

Vaccine Development

Creating advanced vaccines (e.g., Ebola vaccine) to prevent infectious diseases.

Stem Cell Technology

Growing artificial tissues on scaffolds and
using stem cells to regenerate damaged organs and tissues, such as in spinal cord injuries.

Molecular Diagnostics

Developing rapid, accurate tests (e.g., polymerase chain reaction or PCR) for early disease detection

Medical biotechnology uses living cells and microorganisms to create innovative drugs, diagnostics, and therapies. The human genome was fully sequenced by 2007. Recombinant DNA (rDNA) is artificially made by combining genetic material from different sources using restriction enzymes to cut DNA and ligases to join it into vectors like plasmids for amplification.

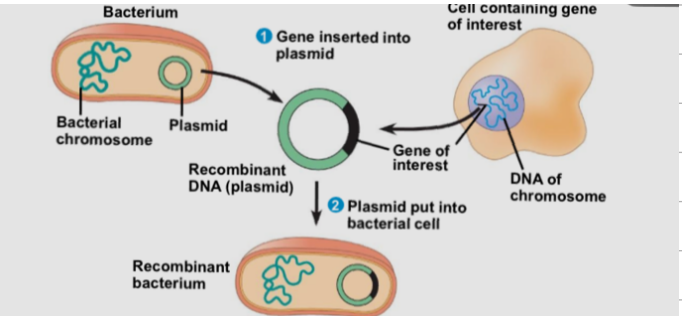
. التكنولوجيا الحيوية الطبية (Medical Biotechnology)
تستخدم الخلايا الحية والكائنات الدقيقة والعمليات البيولوجية لتطوير أدوية وتشخيصات وعلاجات مبتكرة تحسن صحة الإنسان.
تم الانتهاء من تسلسل الجينوم البشري بالكامل بحلول عام 2007.
يُصنع صناعيًا بدمج مادة جينية من مصادر مختلفة، أحيانًا من أنواع .(rDNA) الموقف DNA
وليفاز للصفه في ناقلات مثل البلازميدات لتكثيره DNA مختلفة، باستخدام إنزيمات لقص.

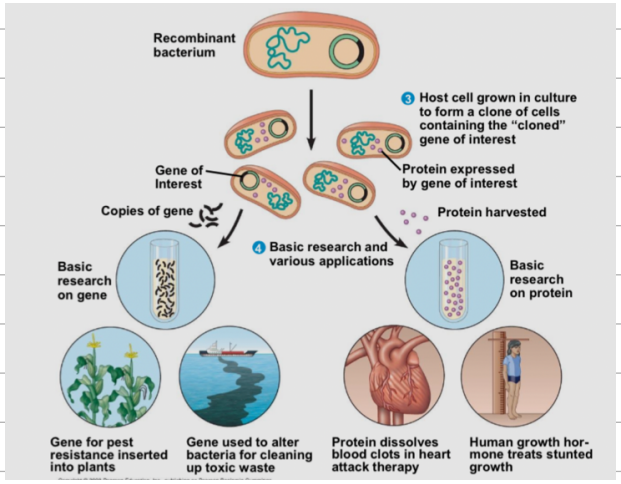
. استنساخ DNA (DNA Cloning)
محددة DNA يعني صنع نسخ متطابقة من جين أو قطعة DNA استنساخ.
هذا يسمح للعلماء بإنتاج نسخ كثيرة من جين معين وبروتينه المرتبط.
غالبًا ما يتم الاستنساخ في المختبر باستخدام البكتيريا وبلازميداتها.
دائرية صغيرة تتكاثر بشكل مستقل عن كروموسوم البكتيريا DNA البلازميدات: جزيئات.

. ناقل الاستنساخ (Cloning Vector)
غريب إلى خلية مضيفة والتكاثر هناك DNA يمكنه حمل DNA هو جزيء.
الغريب في البلازميد، ثم يُدخل البلازميد المؤتلف إلى خلية بكتيرية DNA يتم إدخال.
عندما تتكاثر البكتيريا، تتكاثر البلازميدات معها، مما ينتج نسخ متعددة من الجين الواحد

DNA cloning involves making identical copies of specific genes . Cloned genes are used to produce multiple copies of a gene and its protein. Laboratory cloning often uses bacteria and their plasmids as cloning vectors; plasmids are small circular DNA molecules that replicate independently of the bacterial chromosome.

A cloning vector is a DNA molecule that can carry foreign DNA into a host cell and replicate there
Foreign DNA is inserted into a plasmid, and the recombinant plasmid is inserted into a bacterial cell
Reproduction in the bacterial cell results in cloning of the plasmid including the foreign DNA
This results in the production of multiple copies of a single gene



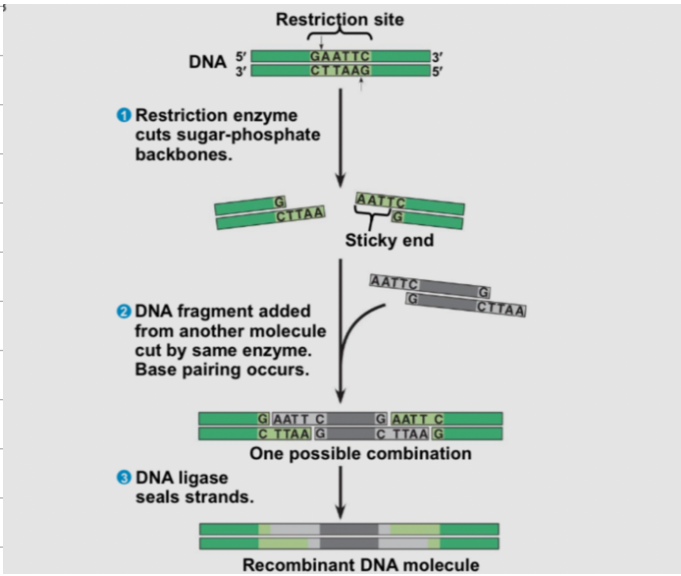


https://youtu.be/evQPGxiG9hs?si=6qrKbVZsxuR7712Y فيديو بيوضح

Bacterial restriction enzymes cut DNA molecules at specific DNA sequences called restriction sites

- A restriction enzyme usually makes many cuts, yielding restriction fragments
- The most useful restriction enzymes cut DNA in a staggered way, producing fragments with “sticky ends” that bond with complementary sticky ends of other fragments.
- DNA ligase is an enzyme that seals the bonds between restriction fragments

- Restriction enzymes : تقطع الـ DNA في مواقع محددة لتكوين قطع DNA.
- Sticky ends : أطراف بعض القطع الناتجة التي يمكن الالتصاق مع أطراف مكملة من قطع DNA أخرى.
- DNA ligase: إنزيم يعمل مثل الغراء ليثبت القطع معًا ويجعل DNA جديد متكامل.

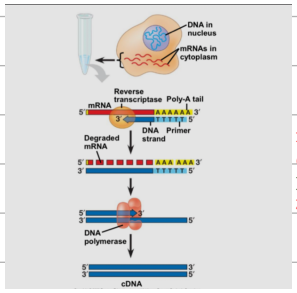


Complementary DNA (cDNA)

فيديو يوضح https://youtu.be/URtcaoNEIrI?si=Ip5j9UlfBOOFeImM

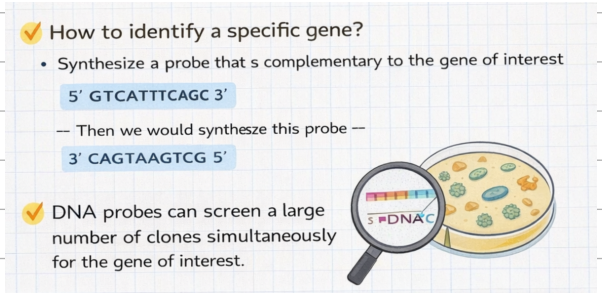
A complementary DNA (cDNA) library is made by cloning DNA made in vitro by reverse transcription of all the mRNA produced by a particular cell.

A cDNA library represents only part of the genome—only the subset of genes transcribed into mRNA in the original cells.



نصنع DNA مكمل (cDNA) من الـ mRNA:
1-عزل الـ mRNA
2-تحويل الـ mRNA إلى cDNA باستخدام إنزيم Reverse Transcriptase
3-جعل الـ cDNA مزدوج السلسة

- A clone carrying the gene of interest can be identified with a nucleic acid probe having a sequence complementary to the gene
- This process is called nucleic acid hybridization.



Expressing Cloned Eukaryotic Genes

Cloned genes can be expressed to produce large amounts of protein for research.

- Protein expression can occur in bacterial or eukaryotic host cells.
- Expression of eukaryotic genes in bacteria faces technical difficulties.
- Differences in promoters and regulatory sequences limit expression.

Use of cultured eukaryotic cells avoids many expression problems.

- Yeast Artificial Chromosomes (YACs):
- Behave normally during mitosis.
- Carry larger DNA inserts than plasmids.
- Eukaryotic hosts perform essential post-translational modifications.

→ يمكنها القيام بـ تعديلات بعد الترجمة (post-translational modifications) مثل:
إضافة السكريات (glycosylation)
تشكيل الجسور الكبريتية (disulfide bonds)
تعديل البروتينات لتصبح فعّالة بيولوجيًا

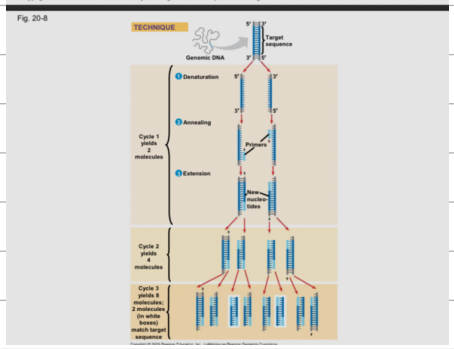
Introduction of recombinant DNA

Electroporation: Electrical pulse creates temporary membrane pores.

- Microinjection: DNA injected using fine needles.
- Introduced DNA integrates into the host genome via natural recombination.

Amplifying DNA *in Vitro*: The Polymerase Chain Reaction (PCR)

- The **polymerase chain reaction, PCR**, can produce many copies of a specific target segment of DNA
- A three-step cycle:
  - Heating
  - Cooling
  - Replication

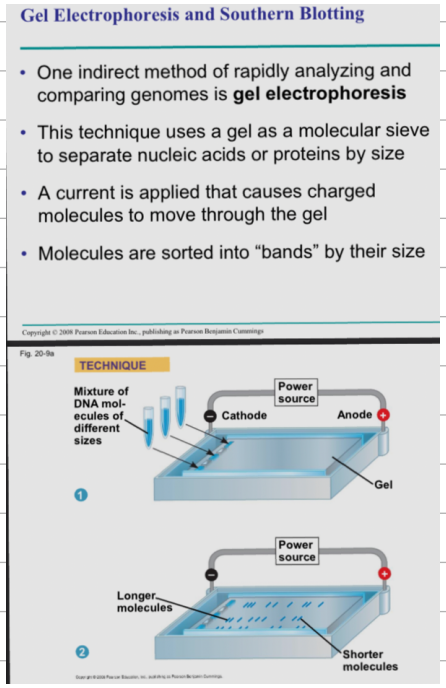


DNA technology allows us to study the sequence, expression, and function of a gene

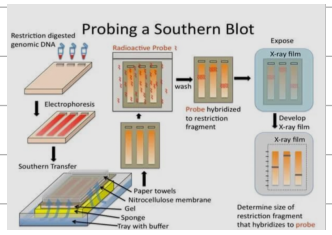
DNA cloning allows researchers to

1-Compare genes and alleles between individuals
2- Locate gene expression in a body
3- Determine the role of a gene in an organism

Several techniques are used to analyze the DNA of genes



Southern blotting



• A molecular biology technique used to detect specific DNA sequences.

انزيمات القطع

• DNA is extracted and cut with restriction enzymes.
• DNA fragments are separated by agarose gel electrophoresis.
• DNA is denatured (double-stranded → single-stranded).
• Fragments are transferred (blotted) onto a nitrocellulose or nylon membrane.
• A labeled DNA probe complementary to the target sequence is added.
• Probe binds to the target DNA by hybridization.
• Bound probe is detected (autoradiography, fluorescence, or chemiluminescence).

Analyzing Gene Expression

• Nucleic acid probes can hybridize with mRNAs transcribed from a gene
• Probes can be used to identify where or when a gene is transcribed in an organism

Determining Gene Function

طريقة معرفة وظيفة الجين

- One way to determine function is to disable the gene and observe the consequences

- Using in vitro mutagenesis, mutations are introduced into a cloned gene, altering or destroying its function

- When the mutated gene is returned to the cell, the normal gene's function might be determined by examining the mutant's phenotype

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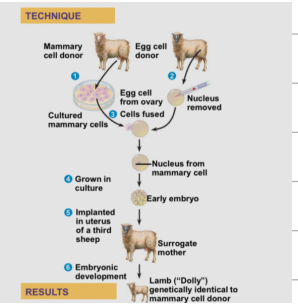
Reproductive Cloning of Mammals

- In 1997, Scottish researchers announced the birth of Dolly, a lamb cloned from an adult sheep by nuclear transplantation from a differentiated mammary cell.



Human Gene Therapy

- Treats disease by modifying or correcting genes in human cells.

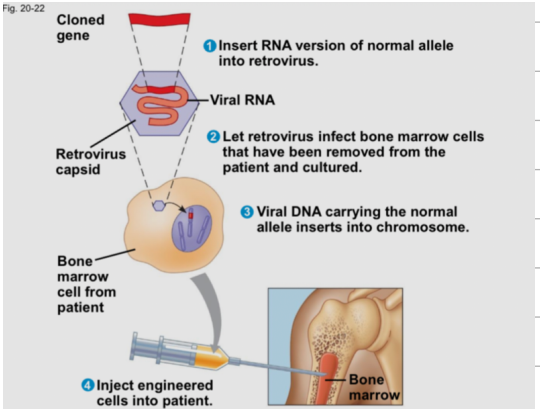
- Uses gene replacement, addition, silencing, or editing.

- Delivered by viral or non-viral vectors.

- Applied mainly to somatic cells (not inherited).

- Used for genetic diseases, cancer, and some infections.

- Limited by safety, immune response, and ethical concerns.



سبحانك اللهم وبحمدك أشهد أن لاإله إلا أنت أستغفرك وأتوب إليك