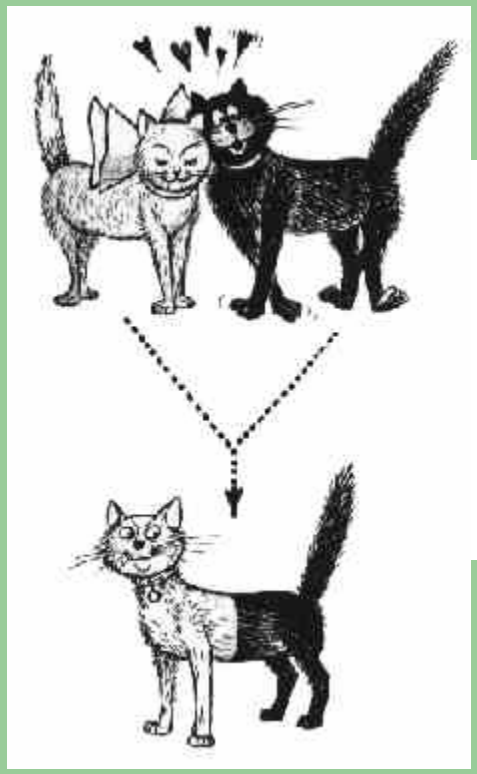
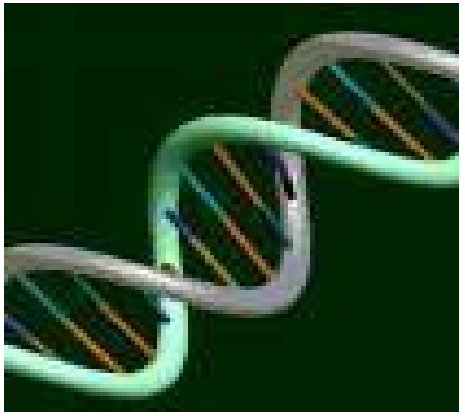




GENETICS

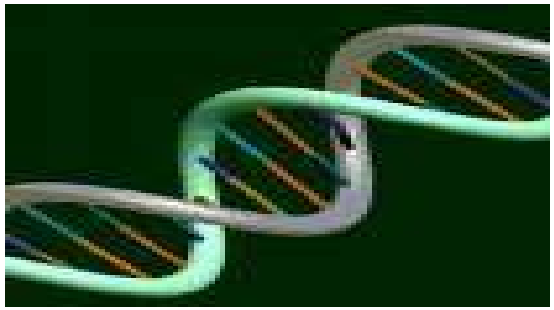
(CE421/521)

-Genetics is one of the most fascinating areas of biology. It has effects at all scales from the molecule to population.

Its study involves a wide variety of tools, from biochemical tests to microscopy to breeding experiments.

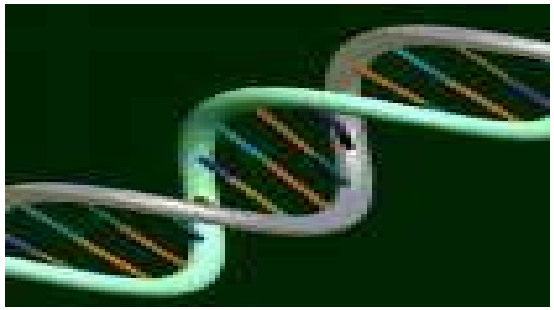
-Genetics is the science of heredity.

Molecular Biology



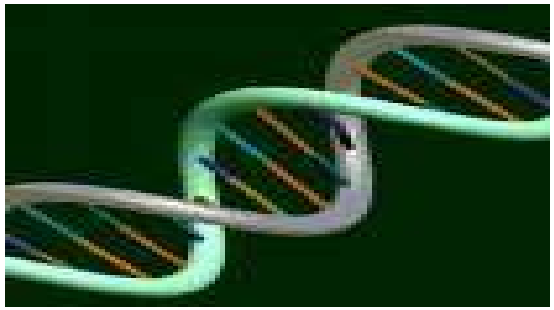
- In recent times the most dramatic advances in biology are coming from the field of molecular biology. Although this title could describe any area of biochemistry, it is usually taken to represent the study of process involving genetic material that controls the activity and destiny of every individual cell.

DNA Replication



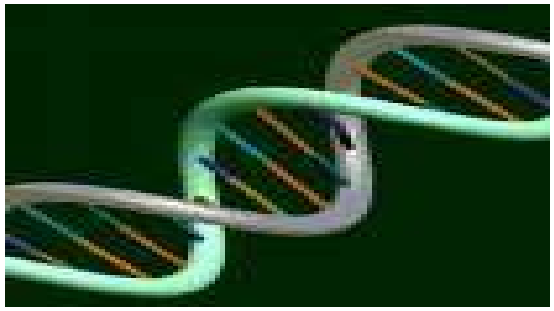
- B strands of DNA (sense and anti-sense) are copied at the same time
- R of replication is always constant (i.e., independent of growth)
- Can't initiate fork in d strand until replication of parents strand is finished
- Initiation of new f increases as growth rate increases
- At least 20 different p and enzymes required for DNA replication (e.g. DNA polymerase)

7 steps:



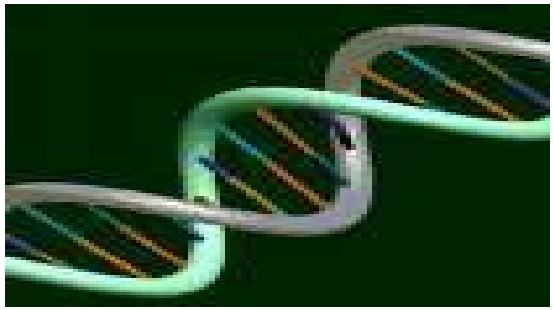
- 1-Recognition of o for replication
- 2-U of DNA strands
- 3-Holding apart of DNA t strands
- 4-I of new daughter strand
- 5-E of daughter strands
- 6-R of daughter strands
- 7-T of replication

Transcription

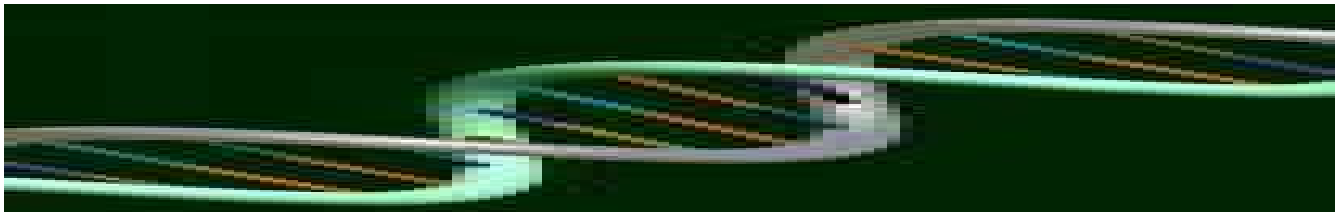


- Process of creating m RNA (mRNA) from segment of DNA b based on start (promoter) and stop signals
- S of DNA encoded for enzymes for a sequential series of reactions is called an operan
- mRNA is the "s copy" of DNA blueprint
- A single mRNA usually contains i for producing a number of related enzymes or may be for a single enzyme
- C by RNA p
- mRNA is u , degrades 2 min. after synthesis (conserves resources)
- Enzyme r and I occurs at the level of transcription

Translation

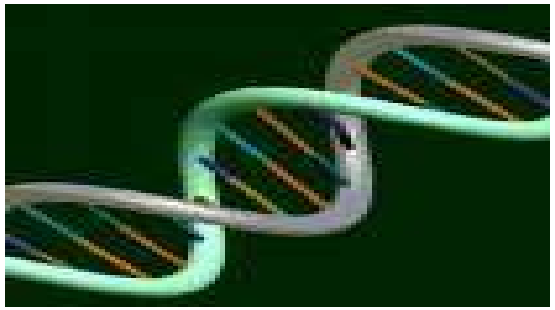


- mRNA contains information for the sequence of a a that make up a protein molecule (e are proteins, protein structure and function depend solely on amino acid sequence)
- Each 3 sequential bases (called a c) specify a particular amino acid, also have codons for start and stop signals for each protein
- tRNA (transfer RNA) will transfer a particular amino acid to the m
- tRNA is smallest of the three types of RNA and is not specific to a particular enzyme, but is particular to an amino acid

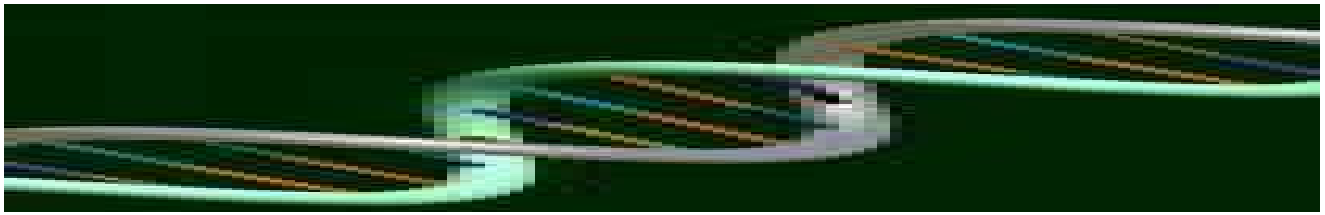


- tRNA has a complementary set of bases called an a specific for the codon on the mRNA
- Amino acids are attached to tRNA, requires e in the form of ATP
- Assembly of proteins occurs on the r (or rRNA), rRNA is the w for protein assemble and constitutes approximately 80-90% of RNA in a cell
- Assemblage of proteins occurs rapidly with about amino acids added per second
- rRNA is not specific to a particular enzyme

Plasmids



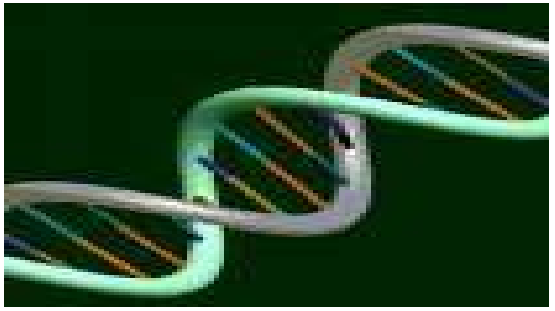
- *A* , self replicating, extrachromosomal, double stranded, circular DNA. Vary in size from 10 to 1000 kbp
- *C* *plasmids* carry genes that code for their transfer to other cells
- *Resistance t* *factors* are plasmids that confer resistance to antibiotics
- Col Factors are plasmids that code for e for degradation of specific xenobiotic compounds (e.g., naphthalene, toluene, salicylate)



Nomenclature:

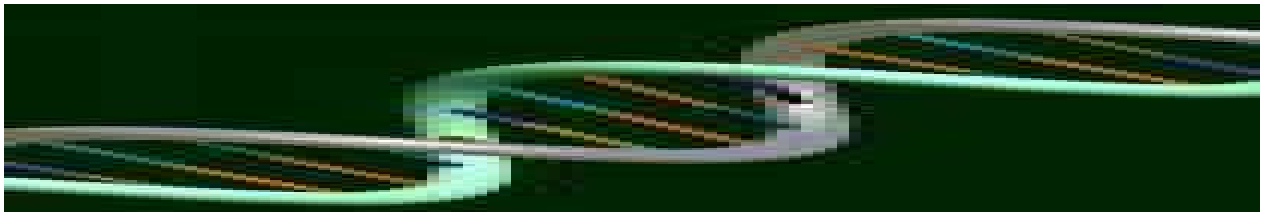
- Copy number low (1-2 copies per cell)-high(10-100cpc)
- Stringency relaxed (do not require replication for amplification) versus stringent (requires replication, therefore not amplified)
- Incompatibility-depends on their ability to coexist within the same cell

Genetic Recombinations



Transformation

- E DNA enters competent recipient
- DNA f splits into two single strands: one strand is integrated into r DNA, other strand is degraded.



Conjugation

- Genetic material (plasmid or DNA fragment mobilized by plasmid) is t from cell to cell by sex pilus during conjugation.

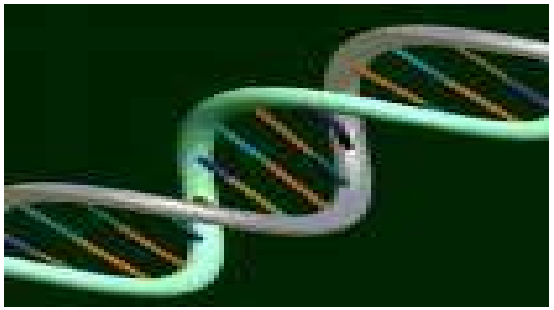
Transduction

- Genetic material is t
  through a bacterial phage (bacteriophage is a virus that attacks bacteria.

Transportation

- Plasmid or chromosomal DNA p
  (i.e., jumps) from one location on the genome to another

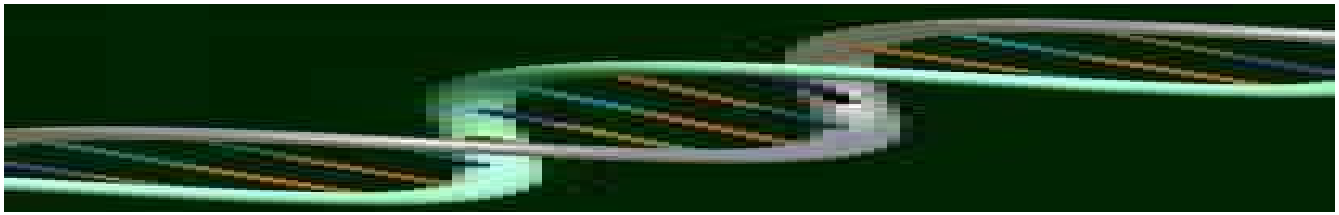
Genetic Engineering



- In v (changes to genome in living cells)
  or in v (changes to genome in test tube)

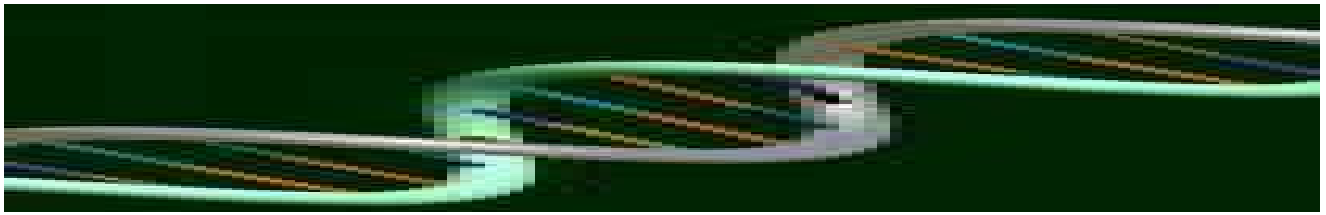
Steps Involved

- I of source DNA.
- DNA f .
- DNA l .
- Incorporation of recombinant DNA into a h .
- Selection of successful c .



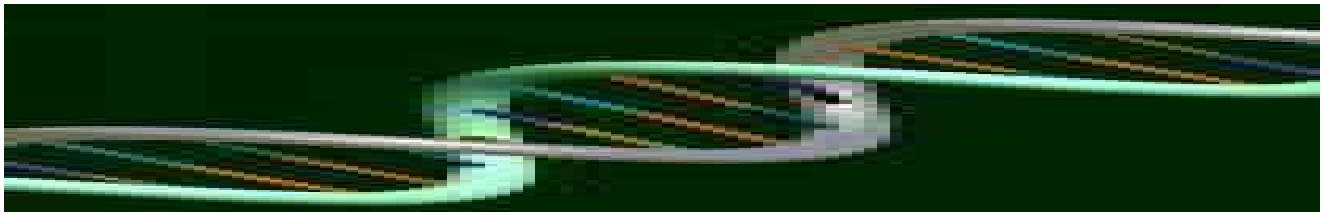
Application of GEMs (Genetically Environmental Microorganism)

- Biodegradation of x (e.g., dioxin)
- Bioremedation; isolates of Pseudomonas that can grow in 50% t .
- Biosensors; l gene codes for luminescence: when biodegradation is occurring culture emits light and luminescence is proportional to degree of d (Gary Saylor's group)

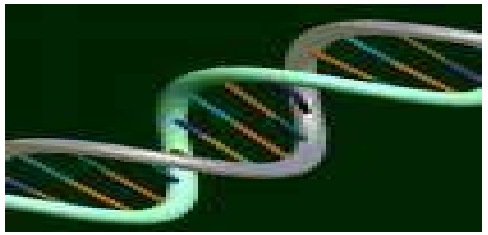


Probe Technology

- Methods to i and q specific microorganisms in environmental samples.
- C based methods
- E microscopy (TEM, SEM)
- A probes
- G probes



- Often are s for 16S-rRNA
- Will bind to complementary sequence on target
- Require a m for identification (fluorescence, radiolabel, etc.)



Environmental Applications

- Detection of .
- Detection of specific g in samples (e.g., metal resistance, antibiotic resistance, degradative enzymes).
- D and enumeration of specific bacteria
- Determination of microbial community s to optimize operational.