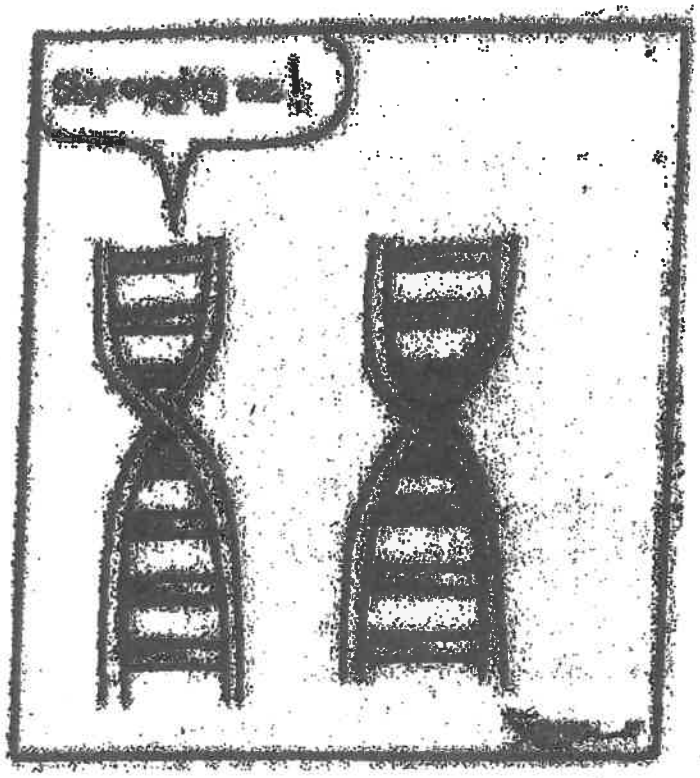
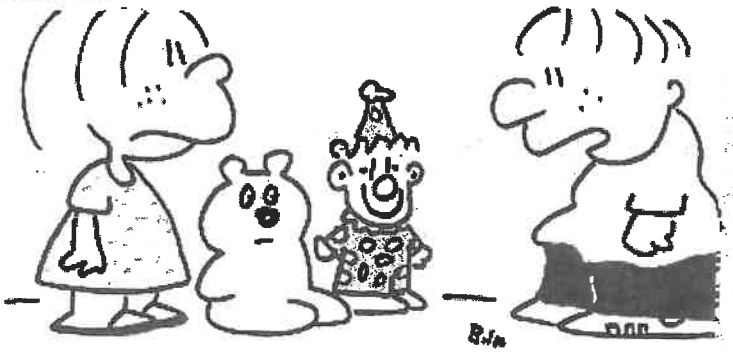
MOLECULAR GENETICS





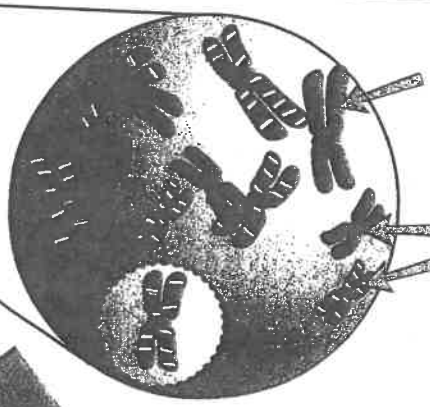
"You're the mother and those are your children? — I'd like to see a DNA test."

Genes, Chromosomes and DNA

This page is a bit tricky, but it's really important that you get to grips with all the stuff on it — because you're going to hear a lot more about it over the next few pages...

1) Most cells in your body have a nucleus. The nucleus contains your genetic material in the form of chromosomes.

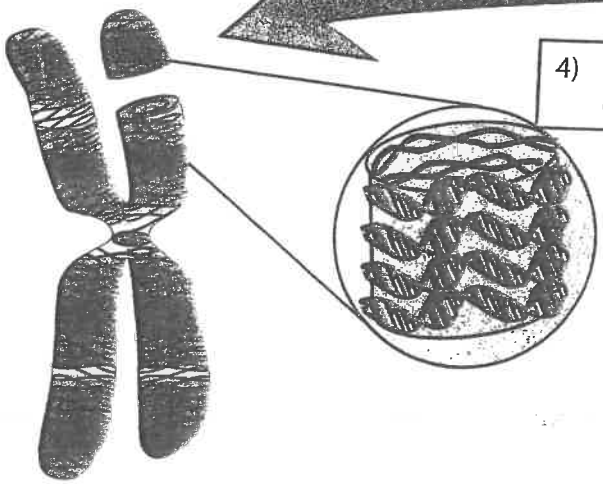
2) The human cell nucleus contains 23 pairs of chromosomes. There are two No. 19 chromosomes, two No. 12s, two No. 3s, etc.



A single chromosome.

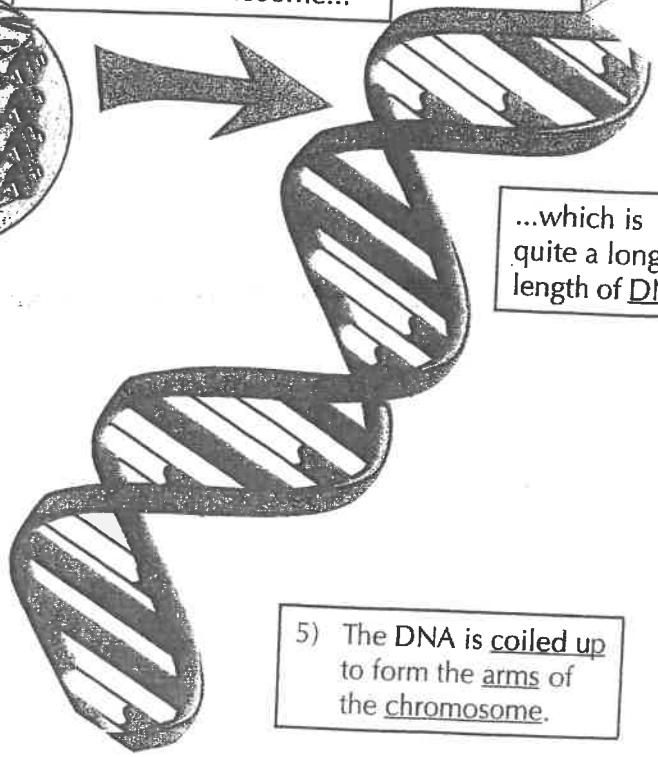
A pair of chromosomes. (They're always in pairs, one from each parent.)

3) Chromosomes carry genes. Different genes control the development of different characteristics, e.g. hair colour.



4) A gene is a short length of the chromosome...

DNA molecule



...which is quite a long length of DNA.

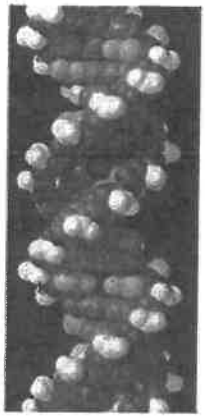
There can be different versions of the same gene, which give different versions of a characteristic, like blue or brown eyes. The different versions of the same gene are called alleles instead of genes — it's more sensible than it sounds!

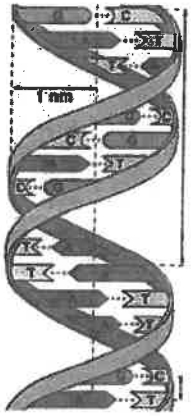
5) The DNA is coiled up to form the arms of the chromosome.

MOLECULAR GENETICS

Molecular Genetics - the branch of genetics concerned with the _____ of genetic material at the molecular level

Genetic Material - chromatin (chromosomes) within the nucleus of the cell
- contains the entirety of an organism's _____
  = its Genome
- this information is encoded in _____





1. DNA Structure

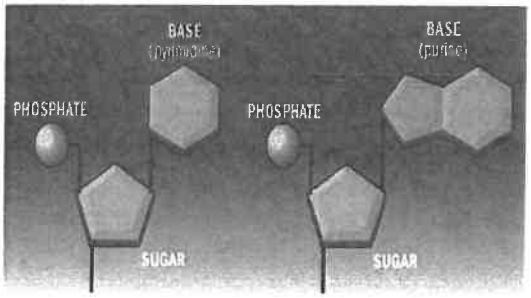
= Deoxyribonucleic acid

-discovery credited to _____ in 1953
: based on the work of Rosalind Franklin

-proposed DNA was a long, double stranded twisted structure
:called this a _____

= looks like a twisted rope ladder

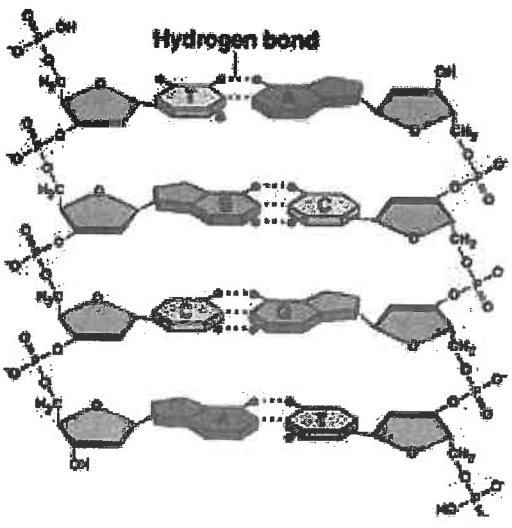
- is composed of subunits called _____
  : 1 nucleotide = phosphate + deoxyribose sugar + nitrogen base
  : there are 4 different nitrogen bases



_____

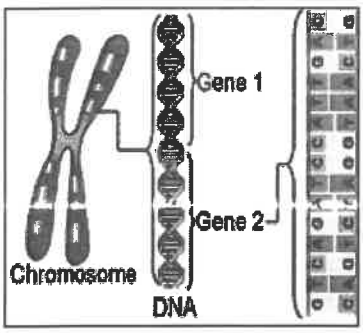
- C and T = pyrimidines
  = have a _____ structure
- A and G = purines
  = have a _____ structure

- nucleotides join together to form a double stranded molecule
  : the sides of the "ladder" are made up of the alternating _____
  while the _____ form the "rungs of the ladder"
- the bases are held together using weak hydrogen bonds & paired based on _____
  : G and C **always** join together _____
  : A and T **always** join together _____
- other pairings do not occur in normal situations



The section of DNA to the right is made up of _____ nucleotides

2. DNA and How Genes Work



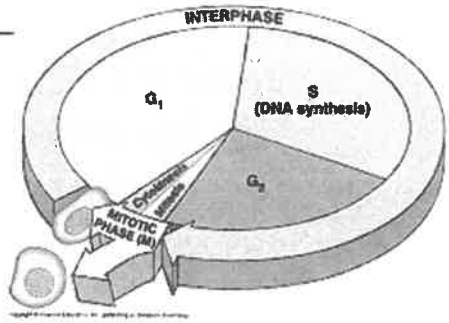
: Genes

- _____ of chromosomes associated with specific traits
- provide the instructions for the manufacture of all of the traits within an organism
  = proteins _____
- as chromosomes are composed of DNA, it is the _____ (order) of the _____ of the nucleotides that provides the _____ or instructions for a trait

= traits are preserved and transmitted through the process of DNA Replication

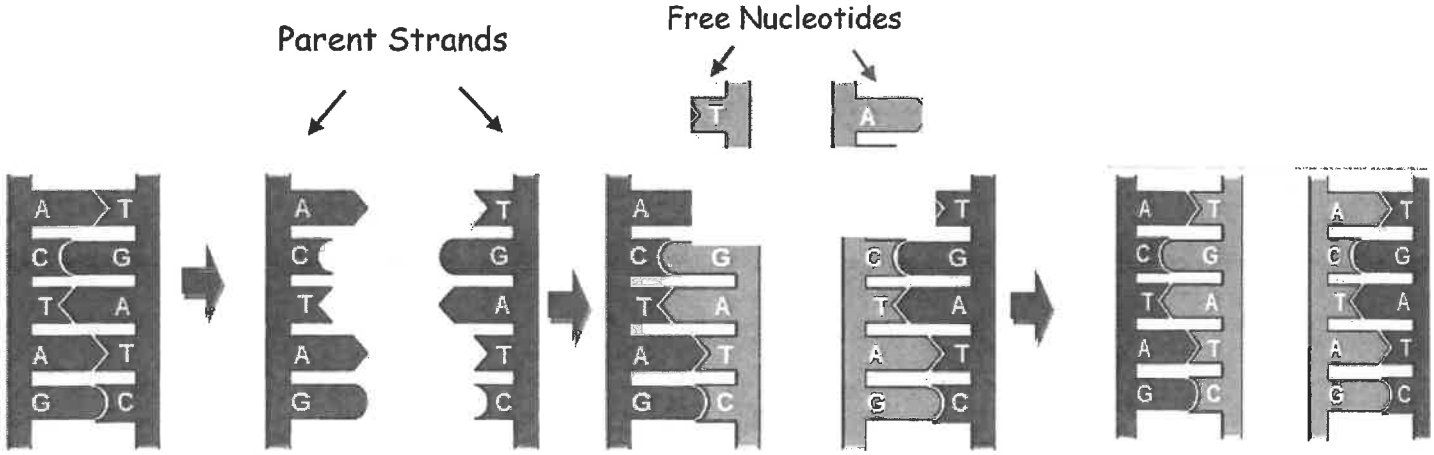
3. DNA Replication

- is the process through which DNA_____
- is the doubling of chromosomes during interphase of the cell cycle
- assures that every cell has identical genetic information after cell division takes place
  = _____



DNA Replication: https://www.youtube.com/watch?v=z685FFqmrpo

- Steps in Replication
  1) DNA molecule_____
  2) The DNA molecule _____ creating 2 parent strands = hydrogen bonds between base pairs are broken by helicase enzyme
  3) DNA molecule _____= DNA polymerase enzyme attaches free nucleotides to corresponding bases on each parent strand making 2 complete DNA molecules
  4) both molecules_____allowing for meiosis or mitosis to begin

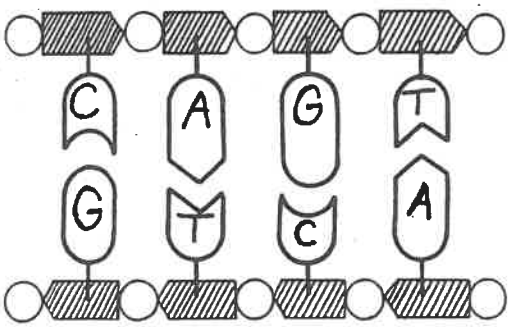


**SEMICONSERVATIVE REPLICATION: parent strand is used as a template
= less chance of _____in the sequence

DNA MOLECULE AND REPLICATION

Name _____

The building blocks of the DNA molecule are nucleotides, which consist of a phosphate, a deoxyribose sugar and a nitrogenous base. In the diagram, label these three substances on the nucleotide. The letters representing the four different nitrogeneous bases are shown in the nucleotides at the right. Place the name of the base next to its letter symbol in the appropriate space.



A = _____

T = _____

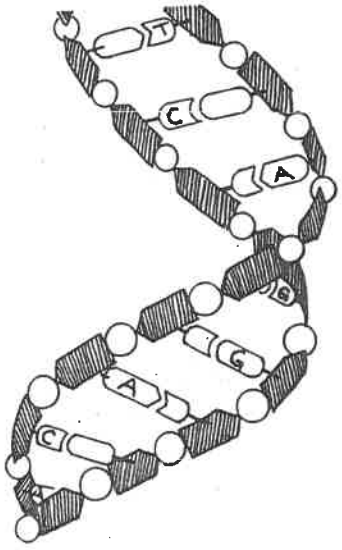
G = _____

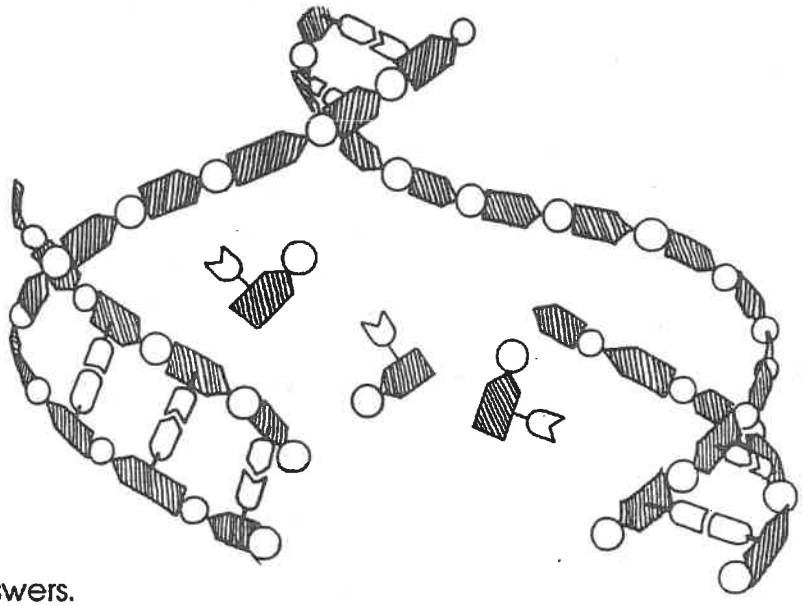
C = _____

The DNA molecule has a double helix shape. Two strands of DNA are coiled around each other and attached by bonds between the nitrogenous bases of each chain. Adenine always bonds with thymine, and cytosine bonds with guanine.

In the illustration at the left below, label a phosphate and a deoxyribose sugar. Fill in the symbol for each base depending on its complementary base in the opposite strand.

The diagram at the right shows the replication of DNA. Fill in the symbol for each base. Label the original strand, a new strand and a free-floating nucleotide.





Fill in the blanks with the correct answers.

The structure of DNA was determined by _____ and _____.

They described the shape of the DNA molecule as a _____.

After replication, _____ identical molecules of _____ are produced. A gene is a sequence of _____ in a DNA molecule.

DNA SONG

(to the tune of Row, Row, Row your Boat)

We love DNA
made of nucleotides.
Sugar, phosphate and a base
bonded down one side.
Adenine and thymine
make a lovely pair,
cytosine without guanaine
would feel very bare.
O-O-Oh, de-oxy-ribo-nucleic acid
RNA is ribo-nucleic acid.
(author unknown)

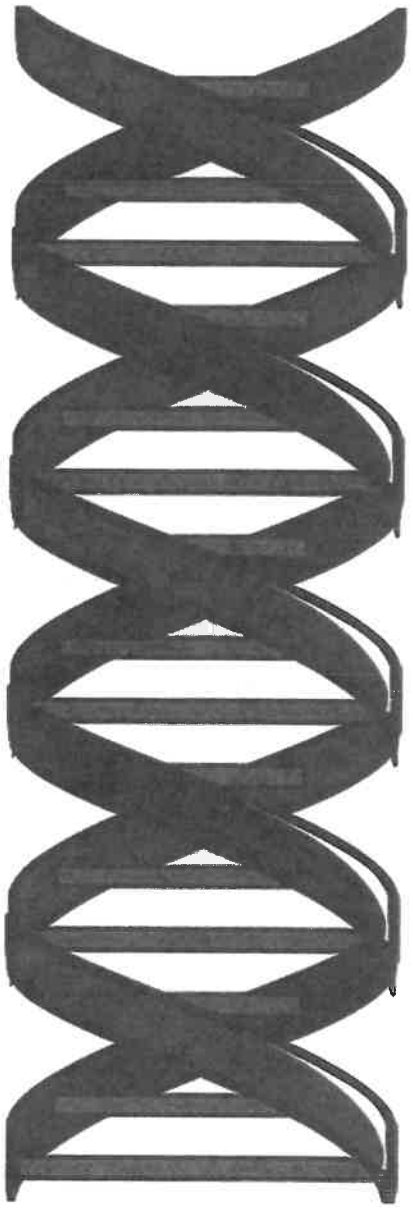
Activity: Construct a DNA Model

Name:_____

Pre-Lab Questions:

1. What three parts make up a nucleotide?

2. List the 4 steps involved in DNA replication.



3. What is a "Parent Strand"?

Instructions

1. Color each of the nucleotides

Thymine = orange | Adenine = green
Guanine = purple | Cytosine = yellow
Deoxyribose = blue
Phosphate = pink

2. Cut out each of the nucleotides (used the dash lines as a guide). Arrange the following on the paper provided to build one side of your DNA strand. This is the parent strand:

TAGCAGTC

3. Glue the parent strand down.

4. Using your parent strand as a template, match and glue each free nucleotide with its appropriate base on the parent strand.

5. Using a red pen draw in bonds between the nitrogen base pairs, 2 lines for double bonds, 3 lines for triple bonds.

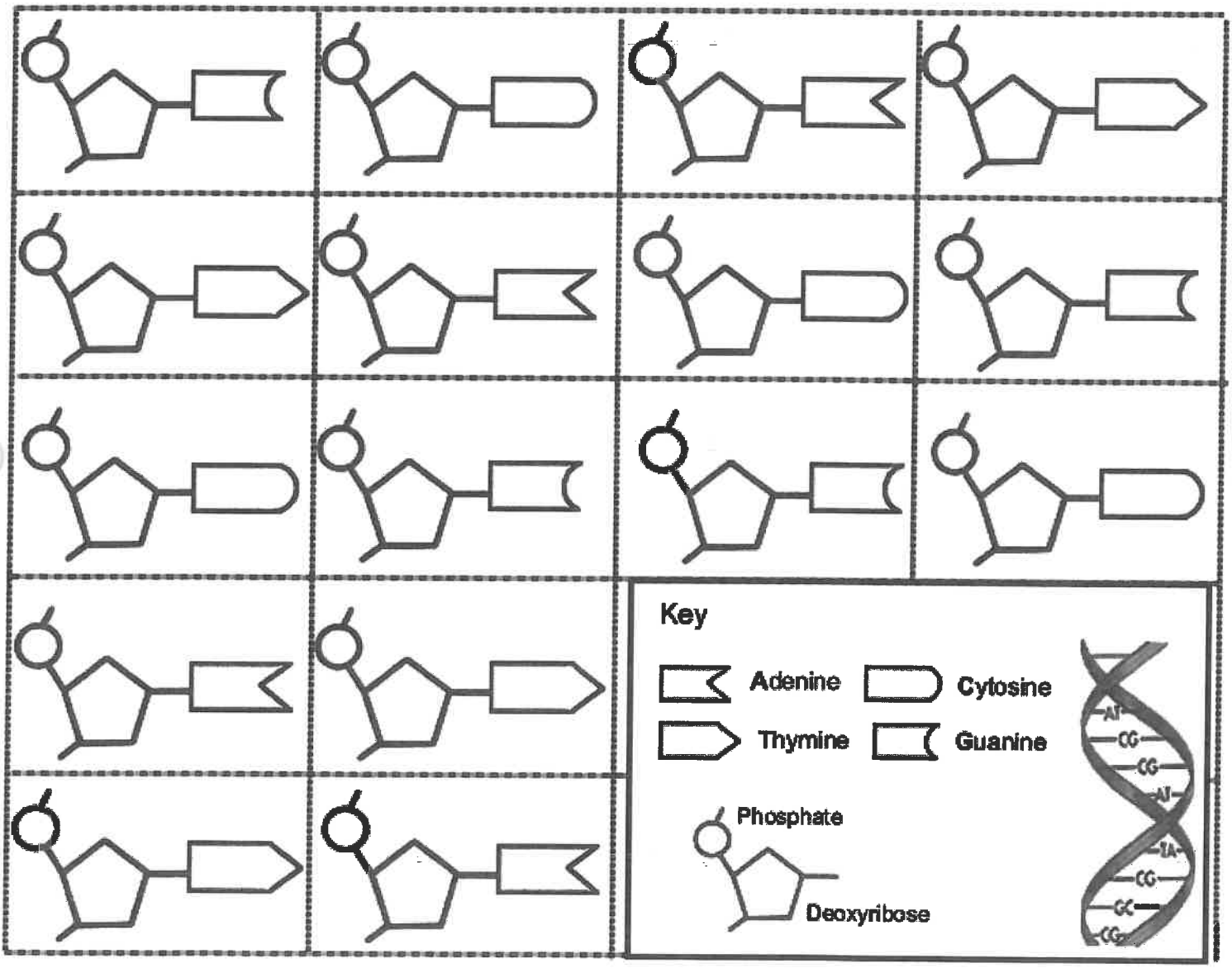
6. Twist your paper to see the shape of the double helix.

Post-Questions:

1. Describe the base-pair rule.

2. Using what you know about the size difference between purines and pyrimidines, Why is it impossible for bases to improperly pair?

3. What is meant by semiconservative replication? Explain its significance.


Key
Adenine
Cytosine
Thymine
Guanine
Phosphate
Deoxyribose

5. Proteins and Protein Synthesis

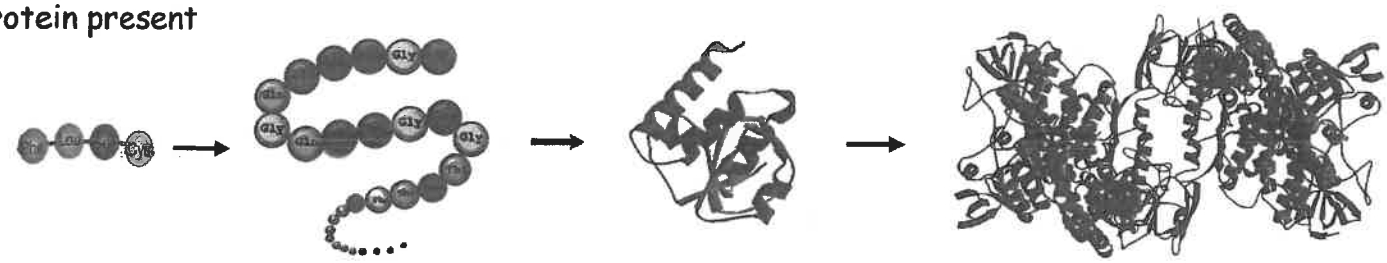
- Proteins

: large complex molecules made up of _____ that make up the traits of an organism

Ie) body structures, hormones, enzymes & antibodies

= make up all the traits in the body (ie. blonde hair, tongue rolling)

: it is the _____ and _____ of amino acids within a protein that determine the type of protein present



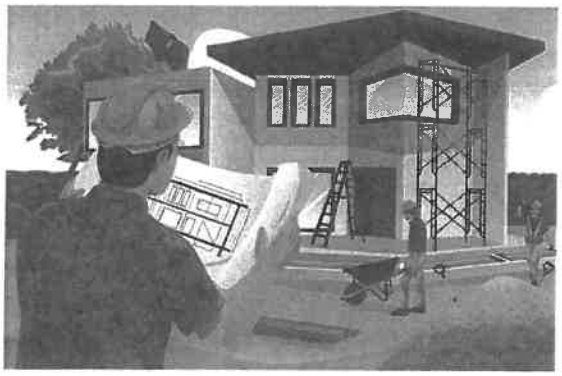
- Protein Synthesis

: the process through which cells make proteins (= making of traits on a molecular level)

: uses the instructions on the _____

= the sequence of the nitrogenous bases in a DNA molecule provide the _____ (instructions) for a protein

: the process of protein synthesis is similar to building a house



= blueprints are used to put the building materials together at a construction site.

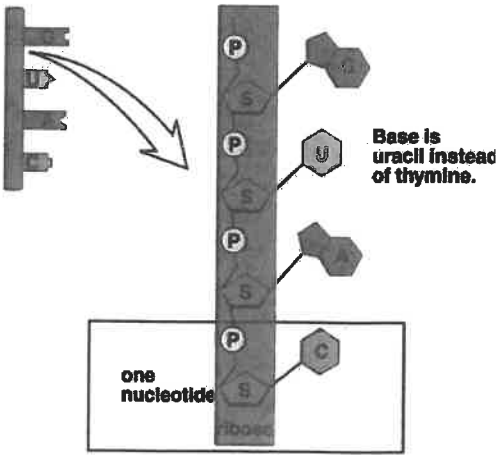
: DNA synthesizes proteins with the help of another nucleic acid called _____

- RNA Structure:

: single stranded molecule (1 side of the ladder)

: made of nucleotides containing:

- ribose sugar instead of deoxyribose sugar
- the same bases as DNA (Adenine, Cytosine and Guanine) except _____ instead of thymine



: there are three kinds of RNA --

1. **mRNA (messenger)**

= the _____ for protein construction

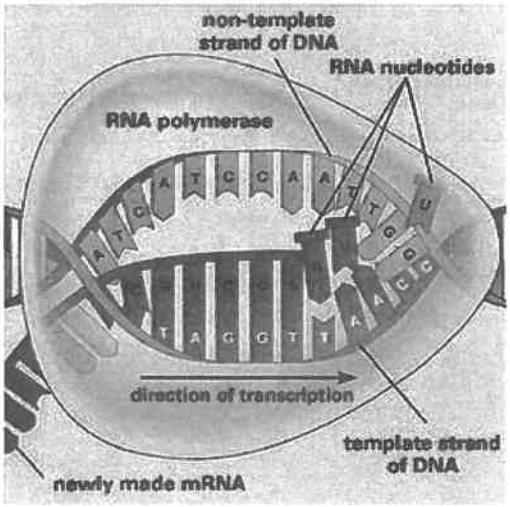
- carries building instructions from the nucleus to the ribosomes
- on a mRNA strand _____ nitrogen bases are called a _____ correspond to a specific amino acid

2. rRNA (ribosomal)
   =_____ where protein is made
   - are the part of the ribosome that mRNA attaches to

3. tRNA (transfer)
   = _____ proper amino acids to the right site at the right time
   - one end of the molecule has an attachment site for amino acids
   - the other end contains an _____
      = 3 exposed bases which match a complementary codon on mRNA
         - Cytosine bonds with Guanine
         - Uracil bonds with Adenine

- 2 Stages of Protein Synthesis

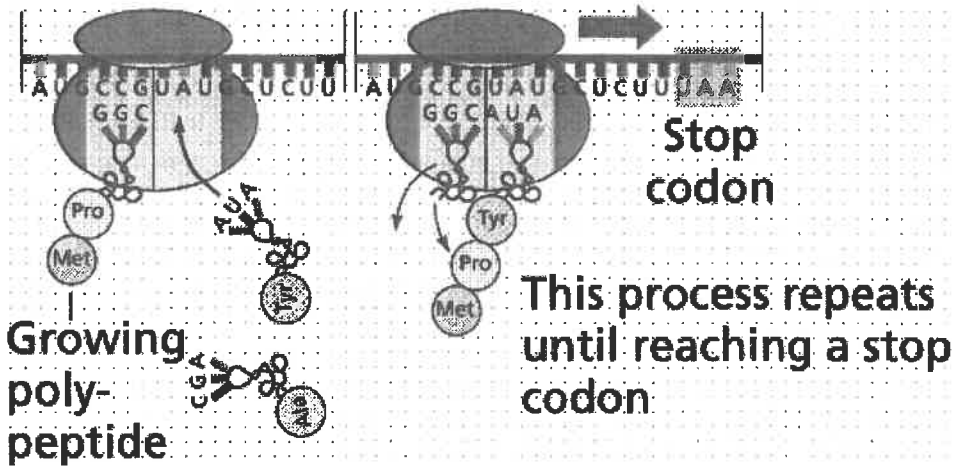
a) **Transcription (in nucleus)**
   = **use DNA to make RNA**



1) DNA _____ (enzyme breaks H bonds)
2) DNA unzips, only _____ of the DNA will be transcribed
3) mRNA constructed out of free nucleotides using a _____ based nucleotide instead of thymine
4) after mRNA is made, H bonds reform & DNA coils again
5) mRNA leave the _____ and carries the code to the _____ in the cytoplasm

b)Translation (on ribosomes)
=**construction of the amino acid sequence**(protein)

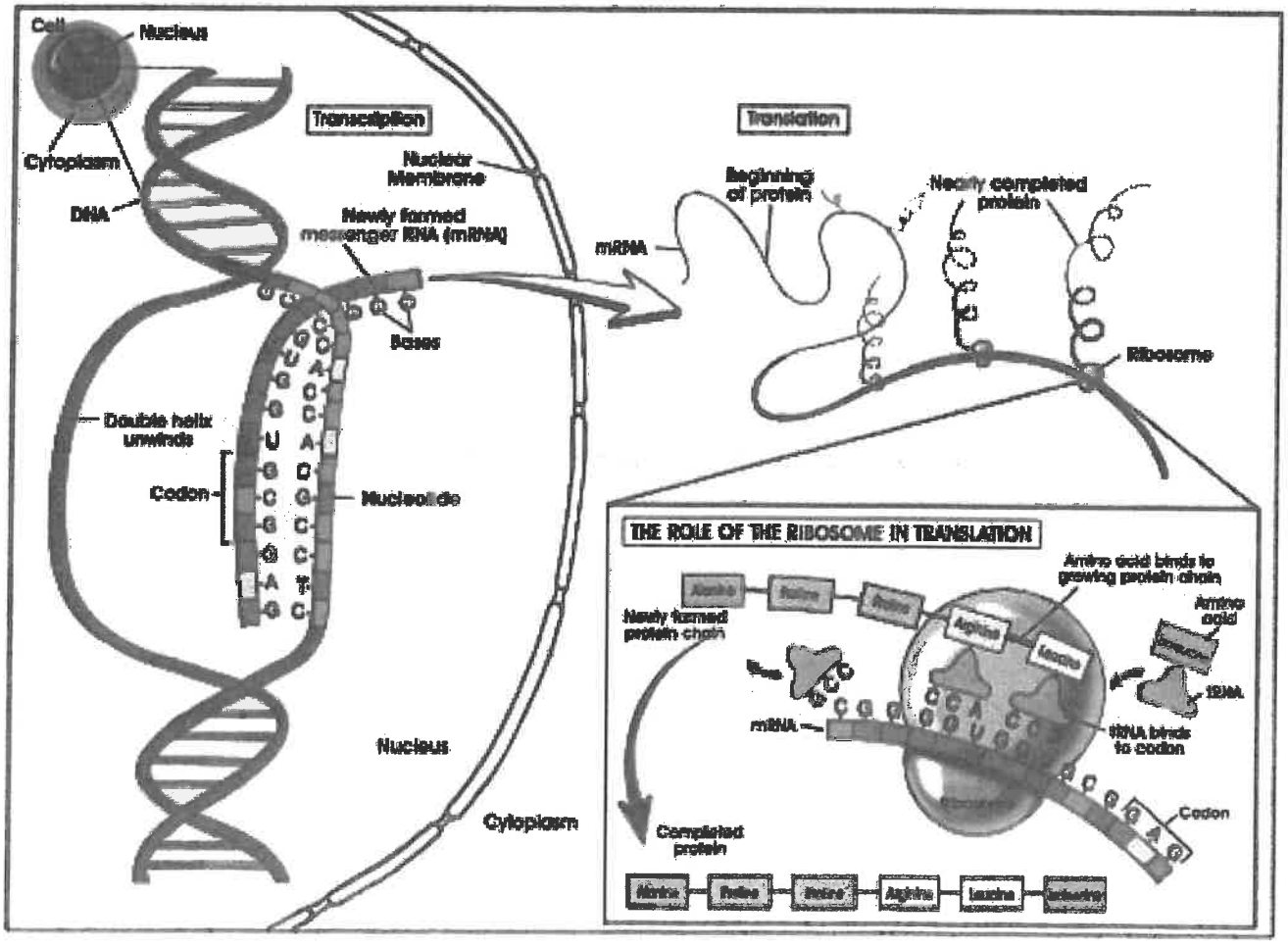
1) mRNA attaches to the _____ and is "read" by helper enzymes
2) tRNA picks up free amino acids in the _____ and carries them to the mRNA
3) codons on mRNA determine the order _____ are delivered by tRNA
4) as the process continues, amino acids are fused into a chain = _____



mRNA Table of Codons

Second letter

First letter	U	C	A	G	Third letter
U	UUU Phenyl-alanine UUC UUA Leucine UUG	UCU UCC UCA Serine UCG	UAU Tyrosine UAC UAA Stop codon UAG Stop codon	UGU Cysteine UGC UGA Stop codon UGG Tryptophan	U C A G
C	CUU CUC CUA Leucine CUG	CCU CCC CCA Proline CCG	CAU Histidine CAC CAA Glutamine CAG	CGU CGC CGA Arginine CGG	U C A G
A	AUU AUC AUA Isoleucine AUG Methionine; start codon	ACU ACC ACA Threonine ACG	AAU Asparagine AAC AAA Lysine AAG	AGU Serine AGC AGA Arginine AGG	U C A G
G	GUU GUC GUA Valine GUG	GCU GCC GCA Alanine GCG	GAU Aspartic acid GAC GAA Glutamic acid GAG	GGU GGC GGA Glycine GGG	U C A G



mRNA AND TRANSCRIPTION

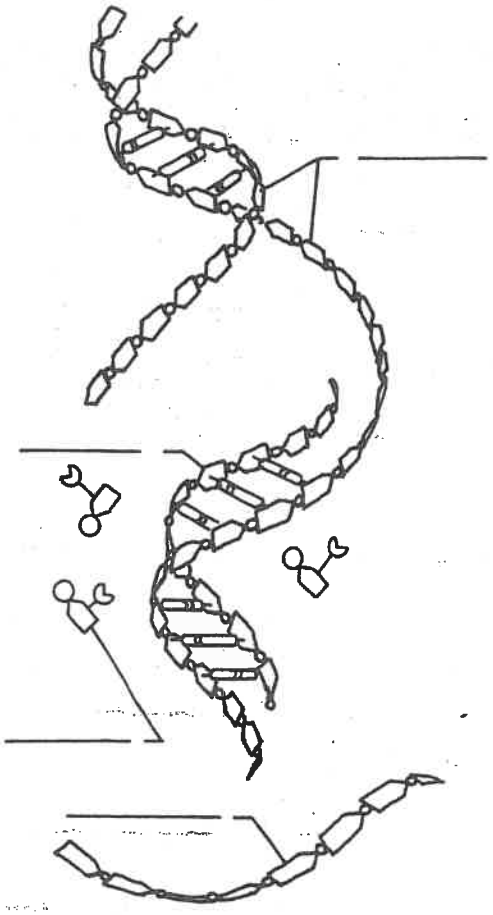
Name _____

Transcription

Fill in the blanks below. On the illustration of transcription, label the DNA, the newly-forming mRNA, the completed strand of mRNA and a free nucleotide.

Messenger RNA (mRNA) carries the instructions to make a particular _____ from the DNA in the _____ to the ribosomes. The process of producing mRNA from instructions in the DNA is called _____.

During transcription, the DNA molecule unwinds and separates, exposing the nitrogenous bases. Free RNA _____ pair with the exposed bases. There is no _____ (T) in RNA. _____ (U) pairs with adenine (A) instead. RNA contains the sugar _____ instead of deoxyribose. The mRNA molecule is completed by the formation of _____ between the RNA _____, and it then separates from the DNA. The mRNA molecule is a _____ strand, unlike DNA.



Codons

Each combination of three nitrogenous bases on the mRNA molecule is a codon, a three-letter code word for a specific amino acid. The table below shows the mRNA codon for each amino acid. Use the table to answer the questions below.

1. The codon for trytophan is _____.
2. For leucine, there are _____ different codons.
3. The codon GAU is for _____.
4. In a stop codon, if the second base is G, the first and third bases are _____ and _____.

Second Base in Code Word

First Base in Code Word	A	G	U	C	Third Base in Code Word
A	Lysine	Arginine	Isoleucine	Threonine	A
	Lysine	Arginine	Methionine	Threonine	G
	Asparagine	Serine	Isoleucine	Threonine	U
	Asparagine	Serine	Isoleucine	Threonine	C
G	Glutamic Acid	Glycine	Valine	Alanine	A
	Glutamic Acid	Glycine	Valine	Alanine	G
	Aspartic Acid	Glycine	Valine	Alanine	U
	Aspartic Acid	Glycine	Valine	Alanine	C
U	"Stop" codon	"Stop" codon	Leucine	Serine	A
	"Stop" codon	Trytophan	Leucine	Serine	G
	Tyrosine	Cysteine	Phenylalanine	Serine	U
	Tyrosine	Cysteine	Phenylalanine	Serine	C
C	Glutamine	Arginine	Leucine	Proline	A
	Glutamine	Arginine	Leucine	Proline	G
	Histidine	Arginine	Leucine	Proline	U
	Histidine	Arginine	Leucine	Proline	C

Biology 30 Case Study

DNA Transcription and Translocation

Procedure :

The following is the base sequence on one strand of a DNA molecule

AAT GCC AGT CCT TCG CAC

1. Give the base sequence of the complementary DNA strand.
2. Draw this DNA strand.
3. Give the base sequence of the strand of mRNA read from the original DNA strand.
4. Draw this mRNA strand.
5. What proten fragment would this mRNA code for?
6. If the fourth nucleotide in the original DNA strand were changed from G to C, what would the resulting mRNA look like?
7. What would the resulting protein look like?
8. If a G were added to the original DNA strand after the 3rd nucleotide, what would the resulting mRNA look like?
9. What would the resulting protein look like?
10. If the 8th nucleotide in the original DNA strand were changed from G to C, what would the resulting mRNA look like?
11. What would the resulting protein look like?

6. Genetic Mutations

- sometimes characteristics in organisms are not traceable to their ancestors

= mutation: _____

- mutations may affect
  - i) Somatic Cells (if unchecked results in cancer)
  - ii) Gametes (resulting embryo would have characteristics not found in either parent)

- There are 2types of mutations:

a) gene mutation

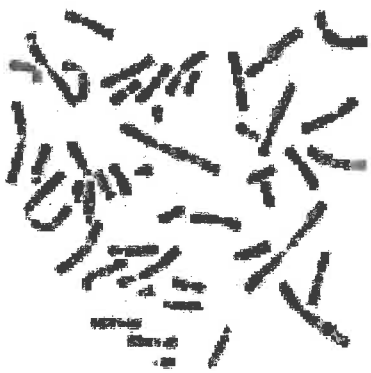
- caused by portions of the DNA which make up a chromosome being _____, _____, _____, or _____
- because it affects only a small portion of a chromosome:
  - : the change is not phenotypical (visible)
  - : usually results in an _____
  - ie. lactose intolerant

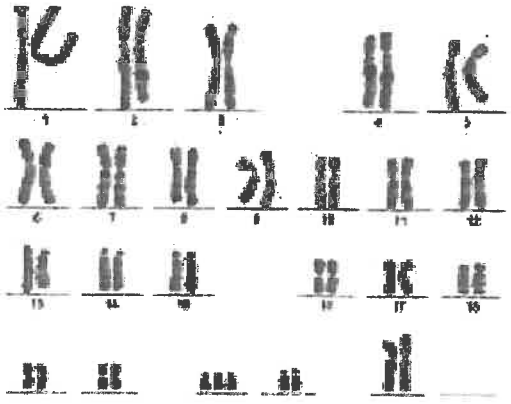
b) chromosomal mutation

- caused by:
  - 1) _____ - failure of chromosomes to split during meiosis resulting in gametes having an extra (or too few) chromosomes
  - 2) _____ or _____ of an arm of a chromosome
- because the change affects a large portion of or whole chromosome:
  - : change is phenotypical = organism looks different from the rest of the species
  - : results in genetic syndromes
  - ie. _____

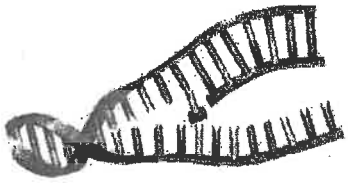
- mutations are generally _____ and are passed on to future generations of offspring
  - : mutations may be beneficial, harmful or have no effect on an organism
- the rate of naturally occurring mutations is very low (1 per 1,000,000 genes)
- _____ - caused mutagenic agents such as temp, chemicals, radiation, etc.

- **Karyotype=** _____
  - a micrograph picture is taken of the chromosomes during Prophase 1 of Meiosis
  - the chromosomes are arranged by size and identified by number
  - used to diagnose Syndromes and Disorders





Mutations Worksheet - Deletion, Insertion & Substitution



There are several types of mutations:

- **DELETION** (a base is lost/deleted)
- **INSERTION** (an extra base is added/inserted)
  - --- Deletion & insertion may cause what's called a **FRAMESHIFT** mutation, meaning the reading "frame" changes, thus changing the amino acid sequence from this point forward
- **SUBSTITUTION** (one base is substituted for another)
  - --- If a substitution **changes** the amino acid, it's called a **MISSENSE** mutation
  - --- If a substitution **does not change** the amino acid, it's called a **SILENT** mutation
  - --- If a substitution **changes the amino acid to a "stop,"** it's called a **NONSENSE** mutation

Complete the boxes below. Classify each as **Deletion, Insertion** or **Substitution** AND as either **frameshift, missense, silent** or **nonsense** (Hint: Deletion & Insertion will always be frameshift).

Original DNA Sequence: T A C A C C T T G G C G A C G A C T

mRNA Sequence: _____

Amino Acid Sequence:

Mutated DNA Sequence #1: **T A C A T C T T G G C G A C G A C T**

What's the mRNA sequence? (Circle the change) _____

What will be the amino acid sequence? _____

Will there likely be effects? _____

What kind of mutation is this?

Mutated DNA Sequence #2: **T A C G A C C T T G G C G A C G A C T**

What's the mRNA sequence? (Circle the change) _____

What will be the amino acid sequence? _____

Will there likely be effects? _____

What kind of mutation is this?

Mutated DNA Sequence #3: **T A C A C C T T A G C G A C G A C T**

What's the mRNA sequence? (Circle the change) _____

What will be the amino acid sequence? _____

Will there likely be effects? _____

What kind of mutation is this?

Mutated DNA Sequence #4: **T A C A C C T T G G C G A C T A C T**

What's the mRNA sequence? (Circle the change) _____

What will be the amino acid sequence? _____

Will there likely be effects? _____

What kind of mutation is this?

Name_____

Karyotyping Activity

Period:_____

In this activity, you will use a computer model to look at chromosomes and prepare a karyotype. You will diagnose patients for abnormalities and learn the correct notation for characterizing karyotypes.
Go to **www.biology.arizona.edu**
Click on **Karyotyping** under human biology.

Introduction:

1. What causes a dark band on the chromosome? _____
_____
2. What 3 things are used for comparison to pair chromosomes? _____
_____
_____
3. What is a centromere? _____

Patient Histories:

*Click on Patient Histories. You will be completing a karyotype for Patient A, B & C.
*Match the chromosome to its homolog. After all the matches are completed correctly you will analyze your patient. (Scroll down to view your completed karyotype).

Patient A (Click on the link to "Complete Patient A's Karyotype")

4. What is patient A's history (summarize) _____
5. How many total chromosomes are in your karyotype - count them _____
6. The last set of chromosomes is the sex chromosomes, if you have two large chromosomes, your patient is XX (female), one large and one small indicates and XY (male) . What sex chromosomes does your patient have _____
7. Which chromosome set has an extra + _____
5. What diagnosis would you give this patient (what disease)? _____

Patient B – (Click on the link to go to Patient B and repeat the above process)

6. What is Patient B's history (summarize) _____
7. Finish the notation for this patient's karyotype : 47 X _____
8. What is the diagnosis? _____

Patient C – (Click on the link to go to Patient C and repeat the above process.)

9. Write out the correct notation for this karyotype. _____
10. What is the diagnosis? _____

Sample Nondisjunction Disorders:

A) Down Syndrome (47 chromosomes)
= extra autosome 21
: diminished mental capacity, round face, enlarged tongue, short in height
: incidence = 1 in 600 births with risk increasing as the age of the mother increases

B) Turner Syndrome (45 chromosomes = X)
= missing 1 X chromosome caused by nondisjunction in the egg so the single X chromosome is provided by the sperm
: are females that do not develop sexually, are short, have widened necks
: incidence = only 1 in 10,000 births as most fetuses miscarry before the 20th week of pregnancy

C) Klinefelter Syndrome (47 chromosomes = XXY)
= extra X chromosome caused by nondisjunction in the egg or sperm
: are males which possess both male and female characteristics
: are sterile
: incidence = 1 in 1000 births

D) Trisomy X (47 chromosomes = XXX)
: wide range of characteristics including basic male traits, mental impairment, short, sterile

E) Trisomy Y (47 chromosomes = XYY)
: "super males"
: taller than average, learning difficulties
: once believed more aggressive and violent = genetic criminals (based on #'s in prison)
= false (is due to learning)

Recombinant DNA Technology

Recombinant DNA technology refers to all the knowledge, tools, and useful products that have come from the scientific research, study, and experiment of Recombinant DNA. This includes genetically engineered foods and animals, peptide hormone medicine, insulin, growth hormone, oxytocin, vaccines, therapeutic agents, and diagnostic technology.

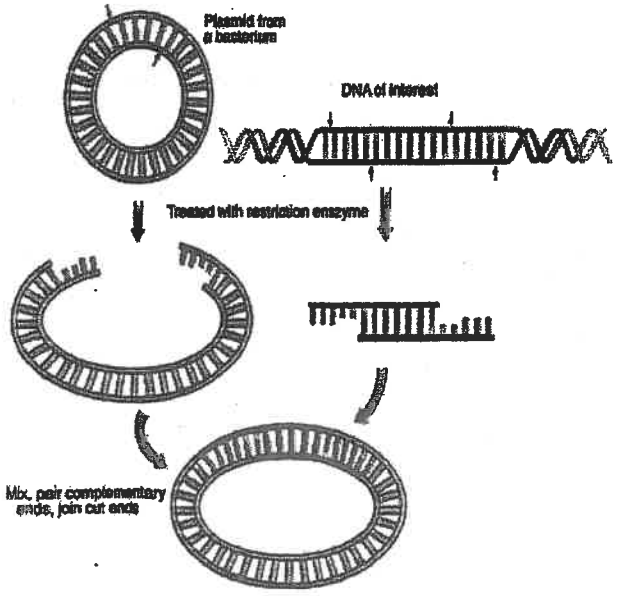
Recombinant DNA (gene splicing): refers to a new combination of DNA molecules that are not naturally found together or are derived from different biological sources and has enabled scientists to provide cheap, pure, and readily available medicines for a variety of illnesses.

Endo-nucleases: special enzymes that cut strands of DNA.

Restriction enzymes: cut strands of DNA at specific sites.

Ligase enzymes: creates biological glue which permits one section of DNA to be fused to another.

Recombinant technology begins with the isolation of a gene of interest. The gene is then inserted into a vector and cloned. The foreign DNA of interest is integrated into the plasmid or phage. Before introducing the vector containing the foreign DNA into host cells to express the protein, it must be cloned. Cloning is necessary to produce numerous copies of the DNA since the initial supply is inadequate to insert into host cells. Once the vector is isolated in large quantities, it can be introduced into the desired host cells such as mammalian, yeast, or special bacterial cells. The host cells will then synthesize the foreign protein from the recombinant DNA. When the cells are grown in vast quantities, the foreign or recombinant protein can be isolated and purified in large amounts.



WLHS / Biology / Oppelt

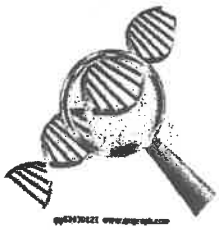
Name_____
Date_____Per_____

BIOTECHNOLOGY WEBQUEST!

INTRODUCTION:

Science involving the understanding and use of DNA has evolved at a revolutionary pace. From the point in which Watson and Crick announced the fundamental double helical structure of DNA, great advances have been made in the application and understanding of this remarkable molecule for all walks of life. Projects such as the **Human Genome**, **transgenic organisms**, **cloning**, **genetically modified foods**, and **crime solving** are just some very common and state-of-the art applications of DNA technology today. But with anything new there are ethical/moral, societal, and political questions to be thought over.

In this activity you will visit 4 webpages and explore some of these exciting and ever-changing topics. Please answer the questions in each section as you work through the webquest / interactive activities.



A) Gel electrophoresis and DNA fingerprinting

http://www.pbslearningmedia.org/asset/tdc02_int_creatednafp2/

As you work through the simulation, read the information in each step and answer the following questions.

1) What is the function of a **restriction enzyme**? What determines the sites where a restriction enzyme works?

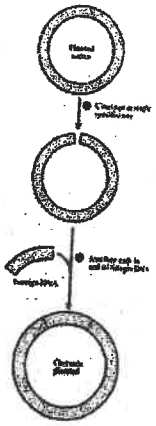
2) What is **electrophoresis**? Why / how does it allow scientists to separate pieces of DNA?

3) Why do you have to add radioactive probe DNA? Without the probes, would the DNA show up on the x-ray film?

4) Which suspect committed the crime? What did you notice about her DNA?

5) Based on the evidence, could any of the other suspects have committed the crime? Why or why not?

B) Transgenic organisms http://www.pbs.org/wgbh/harvest/engineer/



****Work through the interactive and answer the questions below.**

1) List three examples of plant foods / crops we humans have altered in some way.

2) How did humans **first** alter crops? What method are scientists using **today** to change crops?

****Click on "Transgenic Manipulation." Complete this activity. Read the descriptions of each step as you complete them.**

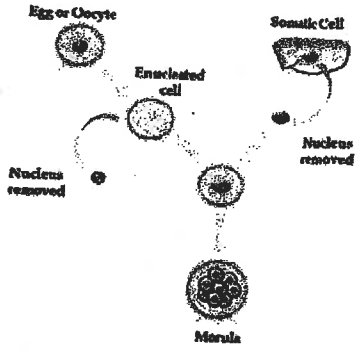
3) What is a **vector**? Why do you think it is possible to take DNA from one organism and successfully put it into another organism?

4) What kind of tomato plant resulted from this experiment? How did you know the plant was resistant to the caterpillar?

C) Cloning http://learn.genetics.utah.edu/

***Click on "Cloning", then on "Click and Clone" to launch the interactive. Work through the interactive and answer the questions below.**

1) What two cells do you need to isolate to clone a mouse? Did these cells come from the same mouse or different mice?



2) What is **enucleation**? What are the blunt and sharp pipettes used for?

3) What needs to happen to the new DNA **before** the process can continue?

4) What is the name for a ball of 16 cells? Where do you put this ball of cells after you have grown it?

5) What color fur did the baby mouse have? Which mouse's DNA was it identical to?

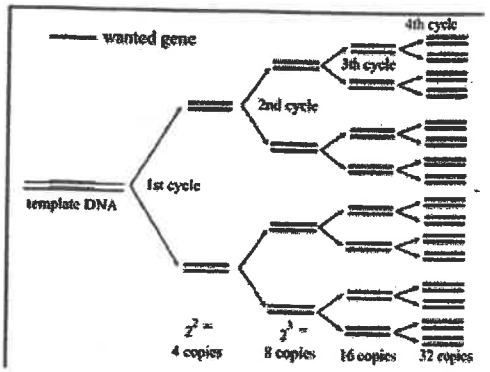
6) Did this really happen? If so, when and at which university?

D) PCR http://learn.genetics.utah.edu/content/labs/pcr/

****Work through the interactive and answer the questions below.**

1) What does PCR stand for, and what do we use it for? What are some applications of PCR that are used every day?

2) Roughly how many base pairs are in the human genome?



3) What are some sources for the DNA needed to perform PCR? (HINT: Which body tissues might be used to isolate DNA from?)

4) Define these terms and describe the role each plays in PCR.

Term	Definition	Role in PCR
Primer		
Nucleotides		
DNA polymerase		

5) How does the thermal cycler work? (Summarize the steps of heating and cooling, including which temperatures are reached, and for what purpose…in other words, what happens at the molecular level during each temperature phase?)

6) How many cycles were needed to make over a billion copies of the desired DNA sequence?

Biology 30: Genetics Unit Review

1. Distinguish (state the difference) between each of the following:
   - A) mitosis and meiosis
   - B) gene and allele
   - C) dominant and recessive
   - D) homozygous and heterozygous
   - E) phenotype and genotype
   - F) somatic cell and sex cell
   - G) autosome and sex chromosome
   - H) gene linkage and sex linkage
   - I) DNA and RNA
   - J) nucleotide and amino acid
   - K) transcription and translation
   - L) codon and anticodon

2. Why is meiosis referred to as reduction division. What event is responsible for reducing the chromosome number? Determining the number of daughter cells formed?

3. List Mendel's 3 Laws.

4. What is the typical phenotypical ratio you would expect from a monohybrid cross? Dihybrid cross?

5. List the 5 points of the Chromosome Theory.

6. What is meant by the term crossing over? What effect does crossing over have on genetic variation?

7. Be able to interpret a pedigree.

8. Draw a simple diagram of part of a DNA molecule consisting of 4 different nucleotides. Use S for sugar, P for phosphate, A for adenine, G for guanine, C for cytosine and T for thymine.

9. What is the purpose of DNA replication? Outline this process in 4 steps. Why is it said to be semi-conservative?

10. What is the purpose of protein synthesis?

11. What are the 3 kinds of RNA. Describe the function of each (use an analogy if you wish).

12. If you had a DNA sequence: AATTCGATCGGGTAC what would be:
    a) the DNA sequence on the complementary strand?
    b) the sequence of transcribed RNA
    c) the amino acid sequence of the protein

13. Describe the relationship between chromosomes, genes, DNA, and RNA.

14. Differentiate between a chromosomal mutation and a gene mutation. What are the biological causes of each? What are the biological results of each?

15. Explain how a pedigree chart and karyotype are useful tools in diagnostic testing.

16. Advancements in the field of Genetics have led to many technological advances. Be able to describe some of these advancements and explain why they are controversial.

Genetics Problems Review Worksheet

For each of the following:

- Identify the genotypes of the parents
- Complete a Punnett Square
- Give the genotypic AND phenotypic results of the cross (percentage OR ratio)

1. In fruit flies, long wings are dominant to short wings. Complete a cross between a short winged male and a heterozygous female

2. In certain flowers, blue and yellow flowers are incompletely dominant to each other. Show the cross between a pure blue flower and a pure yellow flower.

3. In some species of wildcats, blue stripes and purple spots are codominant. Show the cross between a male with stripes and a female with spots and stripes.

4. In humans, blood type is controlled by multiple alleles – A, B & O. Show the cross between a male with Type O blood and a woman with Type AB blood. What blood types will NOT show up in their offspring?

5. In humans, red-green colorblindness is an X-linked trait. Show the cross between a male that is not colorblind and a female that is a carrier.

6. In cats, coat color is controlled by a codominant, sex-linked gene. Calico cats have both orange and black splotches on their white coat. Show the cross between an orange splotched male and a calico female.

7. Oompahs Loomphas generally have blue faces which is caused by a dominant gene. The recessive condition results in an orange face. Oompahs can also have red, blue or purple hair. Purple hair results from the heterozygous condition. Show the cross between an orange-faced, purple-haired male and a heterozygous blue-faced, blue-haired female.

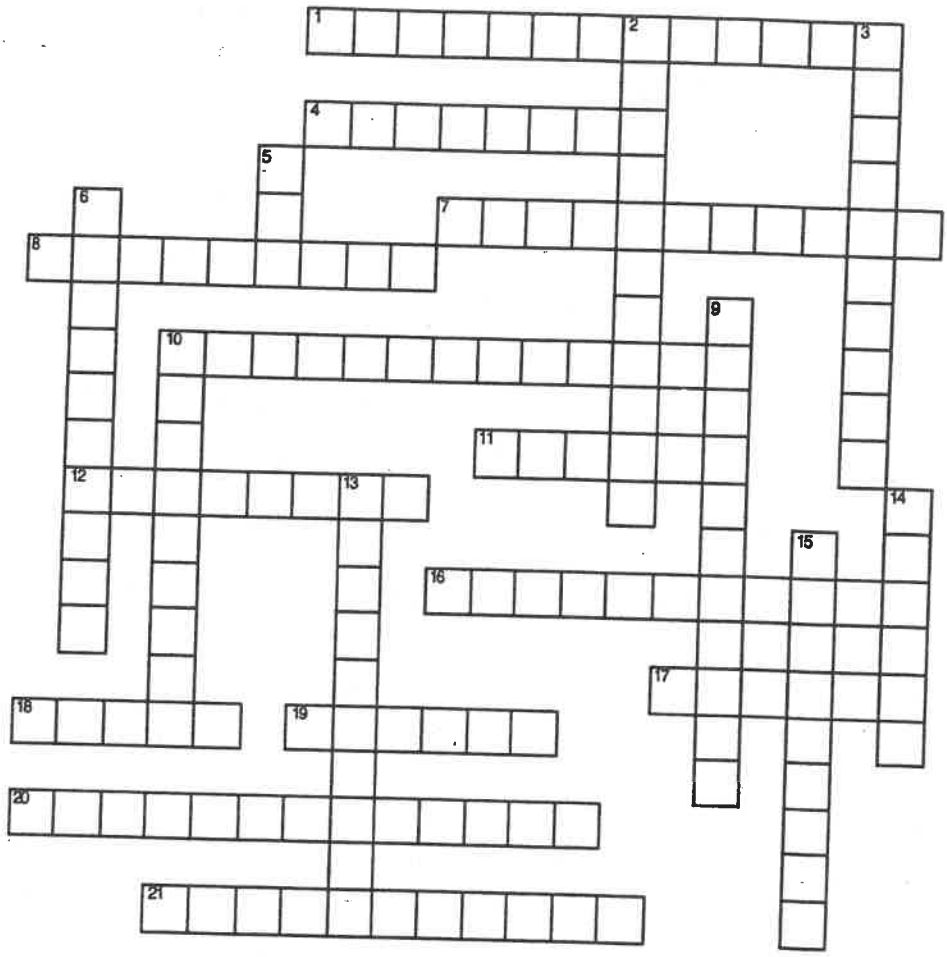
   *Note: this is one of the large, 16-box Punnett squares.

   How many red-haired offspring can they have? _____

   How many offspring are blue-faced and blue-haired? _____

GENETICS CROSSWORD

Name _____



Across

1. Occurs when a segment of chromosome breaks off and becomes reattached to another chromosome
4. An organism that is heterozygous for two traits
7. Humans have 46 of these.
8. Capacity of one allele to suppress the expression of a contrasting, recessive gene
10. Diagram used to predict the results of genetic crosses
11. This base is found in RNA, but not in DNA
12. Genetic makeup of an individual
16. Assembly of a protein molecule according to the code in a mRNA molecule
17. The sugar in RNA
18. Found on chromosomes, they determine specific characteristics of the organism
19. Different form of a gene
20. The process of producing mRNA from instructions in DNA
21. Sugar in DNA

Down

2. Occurs when both alleles are equally dominant
3. Subunit of DNA consisting of a nitrogenous base, a sugar and a phosphate group
5. Double helix in which the genetic code is found
6. Two dominant or two recessive genes for the same trait
9. Process by which DNA makes an exact copy of itself
10. Appearance of an individual due to its genetic makeup
13. Presence of complete extra sets of chromosomes
14. Conducted experiments on heredity in pea plants
15. Site of protein synthesis