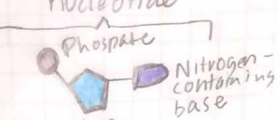
What do we know about the structure of DNA?

70, 47, 74

DNA Structure

nucleotide

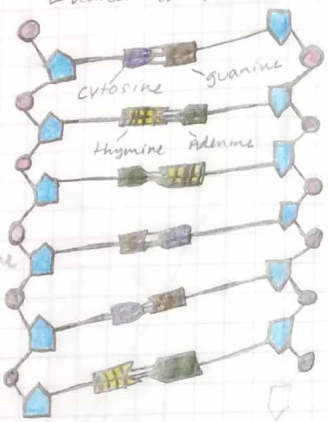


Nitrogen Bases

- Adenine
- Thymine
- Guanine
- Cytosine

* Cytosine and Guanine can only bond w/ each other

Ladder Model of DNA



* Adenine and Thymine can only bond w/ each other

DNA

* DNA is composed of two twisted strands, its shape is called a DOUBLE HELIX

* A NITROGEN BASE is an organic ring structure that contains one or more atoms of Nitrogen

* W/o REPLICATION, species could not survive & individuals would quickly die

What effect do Mutations have?

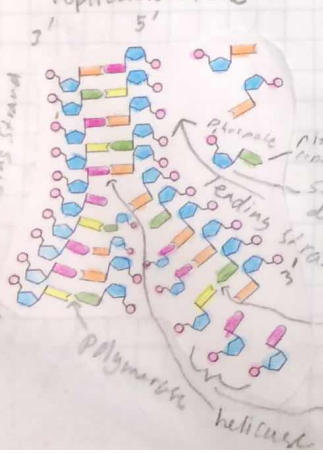
HARMFUL

How are copies of DNA made?

77, 74, 75, 72

DNA Replication

replication fork



1) HELICASE unzips the original strand molecules by breaking the hydrogen bonds b/w the Nitrogen bases

2) POLYMERASE matches "free nucleotides" w/ the open strands moving 3' to 5'

3) On the LAGGING STRAND, nucleotides arrange in clumps called okazaki fragments

4) LIGASE connects the fragments, completing the sequences

5) When replication is complete

Into proteins?

PROTEIN SYNTHESIS

Pg. 83, 82

Transcription: the process of making a copy of one gene from the DNA's strand

Three types of RNA:

- messenger RNA (mRNA; copies DNA code)
- ribosomal RNA (rRNA; makes up the ribosome)
- transfer RNA (tRNA; forms anti-codons and delivers amino acids to the ribosomes)

Translation: the process of matching RNA codons w/ tRNA anti-codons which chains together amino acids to form proteins

+10/10

DNA codon	mRNA codon	tRNA ant	Amino Acid
A	U	A	
A	U	A	Phenylalanine
A	C	G	

Codon: set of 3 DNA or RNA nucleotides

Anti-codon: set of 3 tRNA nucleotides

DNA	MRNA	TRNA
A	U	A
T	A	U
G	C	G
C	G	C

* RNA does not contain Thymine

What happens when a gene is altered?

Pg. 88, 89

MUTATIONS

permanent change in the DNA sequence of an individual

3 Types of mutations:

1. Point Mutations - one base is read incorrectly in replication

ATG CGG
TAC GCC

* can affect 1 amino acid in the protein produced

2. Frame Shift Mutations: one base is added or deleted from the DNA or RNA strand

ATG CTG T
TAC GAC A

* each amino acid after the mutation is affected

3. Chromosomal Mutations: an entire chromosome or piece of chromosome is extra or missing (usually leads to cell)

↓ translocation: genes are broken off one chromosome & transformed to another
can cause leukemia

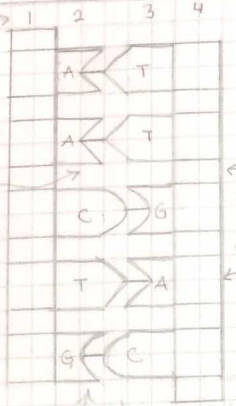
↓ trisomy: one extra (3 copies instead of 2)
Ex. Down's syndrome
trisomy of Chromosome 21

monosomy: one chromosome is missing
Turner syndrome
only 1 X chromosome

Causes of Mutations: natural, radiation, X-rays, ultraviolet rays

what do we know about the structure of DNA? (pg. 60)

DNA is four molecules wide along its entire length



bases can only bond with another base and deoxyribose

Chargaff's rules state that each base at a certain rate at which it appears

Adenine ⇒ 30% } relative
Thymine ⇒ 30% } proportions
Guanine ⇒ 20% } of bases
Cytosine ⇒ 20% } in DNA

A bonds w/ T
G bonds w/ C

DNA is composed of 6 sub-units deoxyribose, adenine, thymine, guanine, cytosine, & phosphate

Phosphates can only bond w/ deoxyribose

Sugar/deoxyribose can bond w/a base and phosphate

DNA consists of 2 strands that are bonded together by Hydrogen bonds

* Discovered by Watson & Crick in 1953 * (pg. 68)

how are gene instructions for proteins made into proteins? (pg. 80)

Proteins: biological molecules used in the body for cell membranes, nails, hair, muscle movement, enzymes, etc (pg. 55)

↓

Proteins are necessary for all bodily functions

↓

w/out Transcription and Translation proteins wouldn't be produced for the body (pg. 80)

release unzips DNA strands

RNA attaches to one of DNA strands

A RNA doesn't contain thymine but it has Uracil

messenger RNA copies DNA strands in "codons" — sets of 3 bases

mRNA takes codons to ribosomes to pair w/ transfer RNA — anti-codons

1 codon / anticodon translates to an amino acid

↓

amino acids linked together

=

proteins

how are copies of DNA made? (pg. 77)

Replication — the copying of DNA molecules (pg. 78)

builds from 3' to 5' end

leading strand

lagging strand

okazaki fragments (pg. 207)

x — helicase unzips the long DNA molecule into 2 strands (leading & lagging)

x — location of replication fork (pg. 25)

n — polymerase bonds free nucleotides w/ corresponding bases on both strands

ligase binds okazaki fragments to complete a strand

builds from 5' to 3' end

what happens when a gene is altered? (pg. 90)

Mutation — change in the sequence of nitrogen bases in DNA

↳ 5 types:

1) Point Mutation — one base is read incorrectly

A T G A C T
T C C T G A

} can affect 1 amino acid
ex: sickle cell anemia

2) Frame Shift Mutation — one base is added or deleted

A T G A C T
T X C T G A

} affect every amino acid after mutated base
ex: tay-sachs disease

3) chromosomal mutations — an entire or piece of a chromosome is added or missing (pg. 91)

1) normal
2) mono-somy
3) tri-somy

} usually leads to cell death
ex: cri-du-chat syndrome; leukemia; turner syndrome

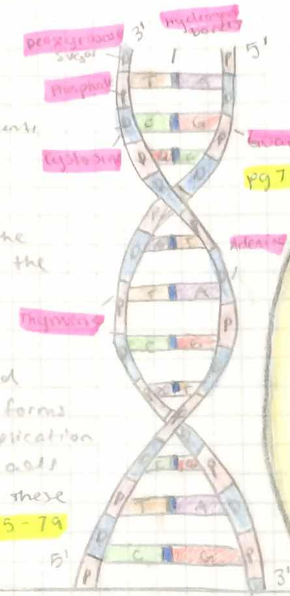
1/15/15

What do we know about the structure of DNA?

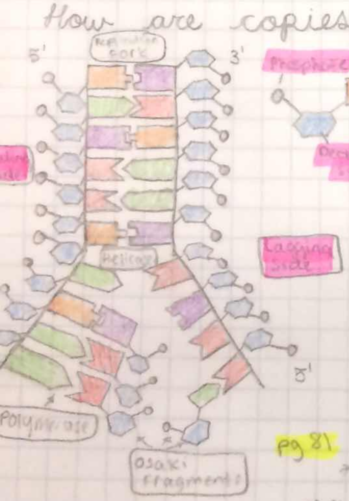
- A DNA strand is made up of pairs of nitrogen bases that connect to deoxyribose (sugar). These sugars then connect to phosphate. All of these elements make up a double helix strand of DNA. pg. 75

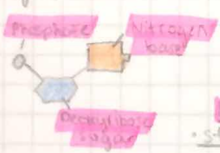
- At one end there is 5' which is the side with phosphate on the end and the 3' side has a deoxyribose on the end. pg 75

- There is one side of the DNA strand that is the leading strand which forms together going up toward the replication fork and the lagging strand leads away from the replication fork. These strand run alongside parallel pg. 75-79



How are copies of DNA made?





- Step one: the replication fork is split down the middle using Helicase.
- Step Two: Once the one strand of DNA become two, polymerase fills it in, ligase replicates and connects the two corresponding nitrogen bases
- Step three: Osaki fragments form, this completely fills in and replicates the original DNA strand, this process goes on, and on creating new cells and DNA by the minute.

pg 81 pg. 79 + 75

Side Note Enzymes are the ones that break the hydrogen bonds in the first place that splits the DNA strand down the middle pg 81

54

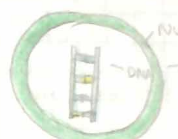
How are gene instructions made into proteins?

- A gene is made into a protein by a complex system called protein synthesis – it involves two main steps: Transcription and translation.
- Transcription part of the synthesis is when mRNA is used to go into the nucleus where the DNA is and it copies one strand
- That one strand now leaves the nucleus and it starts to replicate itself pg 86
- The during translation mRNA codons match themselves with tRNA anti-codons which chains together amino acids and it forms a protein pg 86-89

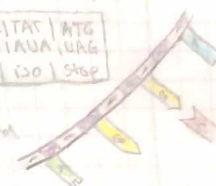
metaphor: library:

Library - nucleus
encyclopedia - DNA
alligator section - gene
notes on the subject - mRNA
taking notes - transcription
computer - ribosome
act of writing the paper - translation
paper written from notes - protein

TAC	CTT	GGG	GAA	TAT	ATG
AUG	GAA	CCC	CUU	AUA	UAG
meth	glu	pro	leu	iso	stop



mRNA copies DNA and takes the info and leaves



Takes the info and reproduces it then it pairs itself w/ codons and anti-codons – 3 amino acids – create a protein.

What happens when a gene is altered?

THREE WAYS TO ALTER A GENE

Point mutations

- one nitrogen base is changed - effects 1 codon and 1 amino acid in the resulting protein

Example: sickle cell anemia

pg 93+94

Trisomy: one extra chromosome.
ex: Down's syndrome
- learning disabilities

Monosomy: one chromosome is missing.
Ex: Turner syndrome

Frame shift mutations

- a nucleotide is added or deleted
- affects remaining codon in the DNA strand
- potentially affects every remaining amino acid

Example: Tay Sachs disease

DELETE

deleted

ATG CTG G
UAC GAC C

ATG CTG G
UCG ACC G

chain reaction each nitrogen base changes

Chromosomal mutations

- chromosomes: bundles of DN[A]
- 23 pairs in the human bo[dy]
- Every individual inherits one type from each of their parents

– Chromo[somes]

pg 93

Translocation:
genes are broken off one chromosome and transferred to another.
ex: Leukemia can occur

4/20 light bulb

What do we know about the Structure of DNA

- vocab
- example

- 2 chains bonded together
- diameter = 4 throughout full chain
- phosphate is only connected to sugar
- bases are bonded only within sugars (specifically 2) and to other bases
- A & T and G & C are bonded in patterns of pairs because they are proven to have the same amounts
- all 6 different atoms are present
- hydrogen bonds connect the bases
- forms double helix as its final shape

pg 68, 69, 70, 71

pg 72, 73, 74, 75, 76, 77

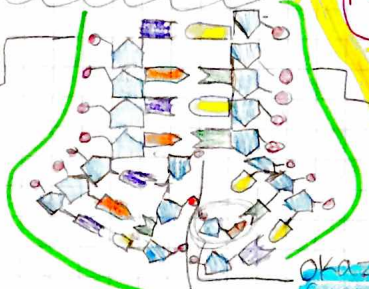
How are copies of DNA Made?

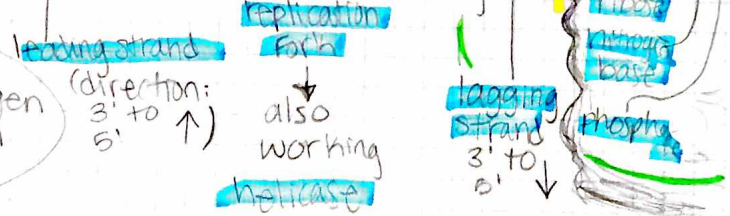
Step 1: the hydrogen bonds between nucleotides break

Step 2: the strands of DNA separate

Step 3: free nucleotides are attracted to exposed bases on the loose strands of DNA

Step 4: Hydrogen bonds between nucleus form



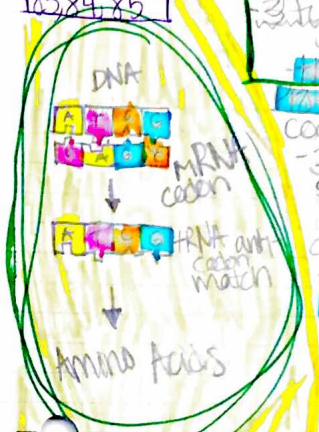


78

How are the gene instructions for proteins made into proteins?

4/10/20

pg 80, 81, 82, 83, 84, 85



pg 88 & 89

RNA: nucleic acid made of nucleotides

- includes: ribose (sugar), Phosphate, Adenine, Uracil, Guanine, Cytosine
- 3 types: mRNA (messenger - copies DNA code), rRNA (ribosomal - makes up ribosomes), tRNA (transfer - forms anticodons + delivers amino acids)

Protein synthesis: creation of a protein using the code in one gene from a strand

- 2 steps: 1) transcription = the process of making a copy of one gene from the DNA strand 2) translation occurs DNA to mRNA and gene info is copied from one side of DNA (mRNA) 3) copy mRNA leaves nucleus for ribosomes - translation = process of matching mRNA with tRNA which chains together to form amino acids to form proteins 1) mRNA brings the complete DNA code strand to ribosome tRNA 2) mRNA codons are matched with anticodons carrying amino acids 3) amino acids link to form protein

What happens when a gene is altered?

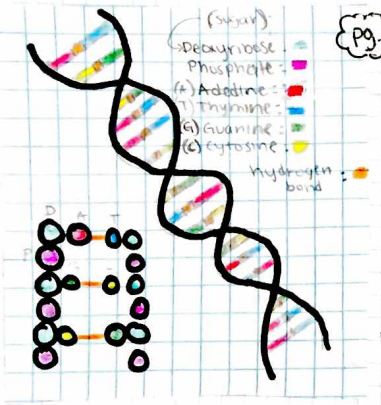
Mutation: permanent change in the DNA sequence of an individual

- possible effects: no effect · beneficial effect OR harmful effect
- 3 types: substitution one base incorrect in sequence (can effect amino acids produced by the sequence)
- frameshift mutation: one base is added or deleted from the DNA or mRNA strand (effects each amino acid after the mutation has affected
- chromosomal mutation: an entire chromosome or piece of chromosome is extra or missing (usually leads to cell death)
- causes: - natural · random events create a variation in species
- environmental: · radiation · X-ray · Ultra violet

DNA Lightbulb

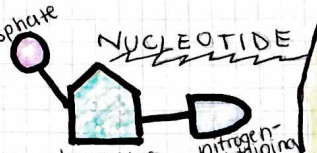
What do we know about the structure of DNA?

- ★ the molecule is anti-parallel
- made up of 6 subunits
- has the same diameter along it's entire length (pg. 69)
- two chains that are bonded together (hydrogen bonds)
  - A + T, G + C
- phosphate cannot bond w/ subunits (only deoxyribose)



pg. 70

4 nitrogen bases
- Adedine (A)
- Thymine (T)
- Guanine (G)
- Cytosine (C)



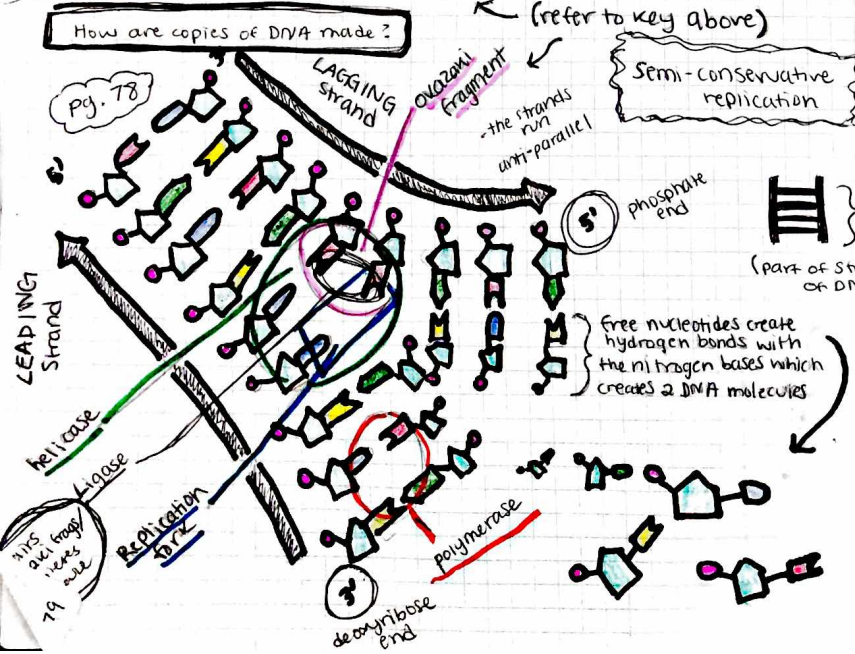
(refer to key above)

pg. 69

How are copies of DNA made?

pg. 78

- Semi-conservative replication (pg. 77)
- the strands run anti-parallel
- Okazaki fragment
- LAGGING strand
- LEADING strand
- 5' phosphate end
- 3' deoxyribose end
- rungs (part of structure of DNA)
- Free nucleotides create hydrogen bonds with the nitrogen bases which creates 2 DNA molecules
- helicase
- ligase
- RNA primer
- Replication fork
- polymerase



How are gene instructions made into proteins?

PROTEIN Synthesis

anti-codon = set of 3 tRNA nucleotides (pg. 69)

codon = 3 RNA or DNA nucleotides (long)

3 types of RNA
1) mRNA (messenger) = copies DNA code
2) rRNA (ribosomal) = makes up ribosome
3) tRNA (transfer) = forms anti-codons; delivers amino acids to ribosomes

Transcription
↳ process of making copy of ONE GENE from the DNA strands
1. helicase unzips DNA btwn nitrogen bases, one gene only
2. info is copied from one side of DNA strand
3. copy (mRNA) leaves the nucleus for the ribosome
4. DNA zips back up (pg. 82)

Translation
↳ process of matching mRNA codons w/ tRNA anti-codons which chains together amino acids to form proteins
1. mRNA brings complementary code from 1 DNA gene to the ribosome (rRNA)
2. mRNA codons are matched w/ complementary tRNA anti-codons carrying amino acids
3. amino acids link to form proteins

+ 10/10

What happens when a gene is altered?
↳ mutations may form

DNA	TAC	GAG	TAG	TCA	
mRNA	AUG	CUC	AUC	AGU	
amino acids	meth	leu	ile	ser	

3 types of mutations

1. Point Mutations
   - 1 nitrogen base changed
   - effect 1 codon; therefore 1 amino acid in the resulting protein
   - Ex: Sickle cell anemia
   - presentation will matter
2. Frame-shift mutations
   - a nucleotide is added or deleted
   - affects remaining codon in DNA stra
   - potentially affects every remaining amino acid
3. Chromosome = bundles of DNA
   - humans have 23 pairs of chromos
   - every individual inherits one of each type from each of their parents