Gene to Protein

inherited DNA leads to specific traits by dictating the synthesis of proteins

From Gene to Protein (cont.)

Gene expression	process by which DNA directs protein synthesis (2 stages)
Transcription	the synthesis of RNA using a DNA template
Translation	the synthesis of a polypeptide using the genetic information encoded in mRNA. (nucleotides to amino acids)

Achibald Garrod

inborn errors of metabolism	inherited diseases when a person can't make a specific enzyme (no gene for enzyme bc of mutation)
ex.	alkaptonura
	pee is black because no enzyme exists to break down alkapton

Beadle and Tatum

one gene-one polypeptide hypothesis	gene dictates the specific production of an enzyme
	(gene codes for a polypeptide aka protein aka enzyme)

DNA vs. RNA

	DNA	RNA
strands	double and anti-parallel	single
3 part of nucleotides: 5-C sugar:	deoxyribose	ribose
phosphate group:	present	present
nitrogenous base	C, G, A, T	C, G, A, U

3 Types of RNA

mRNA	synthesized using DNA template, attaches to ribosome in cytoplasm and specifies the primary structure of protein
rRNA	molecules...and proteins make up the *ribosomes*
tRNA	translates between nucleic acid (DNA) and protein lang. by carrying specific amino acids to ribosome, where they recognize the appropriate codons in the mRNA

PROTEINS ARE ASSEMBLED ON RIBOSOMES

TRANSCRIPTION is DNA-directed synthesis of RNA

eukaryotes	*nucleus* (where DNA is)
prokaryotes	*cytoplasm*
RNA polymerase II	binds to DNA and separates DNA strands
	pastes complimentary RNA nucleotides to one side of DNA strand
	= messenger RNA

RNA polymerase DOES NOT need a *primer*

Transcription (cont.)

promoter	DNA sequence where RNA polymerase II starts transcribing
terminator	DNA sequence where RNA polymerase II stops transcribing
transcription unit	the entire stretch of DNA transcribed in mRNA

3 Stages of Transcription:

initiation	after RNA polymerase binds to the *promoter*, the DNA unwinds and initiates RNA synthesis
	prokaryotes do this themselves
	eukaryotes use proteins called **transcription factors** to assist bind of RNA polymerase to strand

3 Stages of Transcription: (cont)

	TATA box helps position mRNA polymerase
Elongation	RNA polymerase moves downstream, unwinding and elongating
Termination	polymerase transcribes a sequence in DNA signaling end, RNA transcript is released, polymerase detaches from DNA

Modifying mRNA after Transcription

ends of pre-mRNA molecule are modified before leaving the nucleus

GTP cap	5' end receives guanine triphosphate cap
poly-A tail	3' end gets adenine nucleotides
RNA is made of :	exons (expresses code) and introns *from DNA*
	INTRONS are cut out, while EXONS are spliced together by **RNA splicing**
RNA splicing signals are at both ends of an INTRON	protein **spliceosome** snips out intron from transcript
	enzyme of protein = **ribozymes**

Genetic Code

DNA and RNA	polymers of *nucleotides*
nucleotides differ in bases	A,T,C,G vs. A,U,C,G
Genetic code	'language' of mRNA instructions
codon	mRNA, 3-letter word
	3 nucleotide that code for an *amino acid*
UCG =	amino acid *methionine*
proteins	amino acids join in polypeptide

ALL proteins have a start (AUG) and terminator codon

Translation

prokaryotes & eukaryotes	*cytoplasm on the ribosome*
mRNA	left nucleus, now in cytoplasm, *binds to ribosome*
rRNA	ribosome composed of rRNA and protein; adds amino acids to polypeptide chain
- 3 binding sites:	**A site**: holds the tRNA that carries the next amino acid
	P site: holds the tRNA that carries the growing polypeptide chain
	E site: exit site for tRNA
tRNA	transfers amino acids to ribosome
	other end of tRNA has **anti-codon**

- reference drawing for explanation -

_

polyribosomes

mRNA can be translated simultaneously by *several* ribosomes

transcription / translation of BACTERIA cells occurs at same time because they're both in the CYTOPLASM

Mutations

alteration in the genetic information of a cell

point mutation - affects one nucleotide pair

nucleotide-pair substitution - replacement of one nucleotide and it's complementary base pair in DNA

1. **silent mutations** do not change amino acid translation

2. **missense mutation** substitution when a codon still codes for an amino acid

3. **nonsense mutations** - substitutions when a regular amino acid codon is changed into a stop codon, ending translation

Mutations (cont.)

insertion and deletion - addition / loss of nucleotide pairs, can cause *frameshift*, mRNA read wrong

mutagens - forces that interact with DNA in ways that cause mutation

ex. x-rays

REMEMBER:
- most genes only contain instructions for assembling proteins
- many proteins = enzyme
- can control color of a flower