More Heredity Problems You've Inherited From Your Teacher

In class examples

Example 1: a) Show why the possibility of getting a baby girl is 50%.

	X	Y
X	X X	X Y
X	X X	X Y

2 XY /4 possibiliites * 100% = 50%

b) If you already have three girls, is the possibility of giving birth to another girl still 50%?

Yes. Probability has no memory.

c) Which of a man's grandparents could not be the source of any of the genes on his **Y**-chromosome?

The grandmother.

Example 2: Some human traits are sex-linked, usually meaning that only the X chromosome can carry the gene. Hemophilia in humans is due to an **X**-chromosome mutation. What will be the results of mating between a normal (non-carrier) female and a hemophilac male?

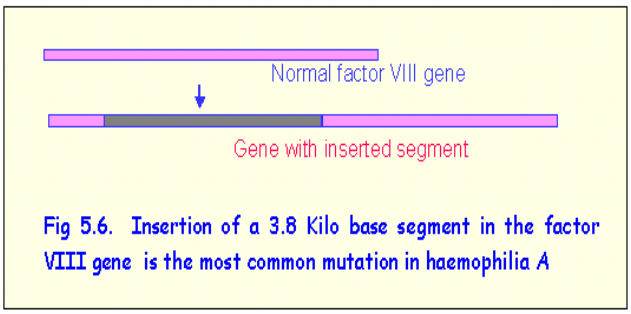


Fig 5.6. Insertion of a 3.8 Kilo base segment in the factor VIII gene is the most common mutation in haemophilia A

	X^n	Y
X^N	XX^n	X^NY
X^N	XX^n	X^NY

There's a 50% chance of having a normal boy (X^NY)and a 50% chance of getting a female carrier(XX^n **)**

Another way of expressing this is:

If it's a girl, there's a 100% chance that she will be a carrier.

If it's a boy, there's a 100% chance that he will be normal.

Example 3 A human female "carrier" who is heterozygous for the recessive, sex-linked trait causing red-green color blindness, marries a normal male. What proportion of their male progeny will have red-green color blindness ?

	X^N	Y
X^N	$X^N X^N$	$X^N Y$
X^n	$X^N X^n$	$X^n Y$

½ = 50% of the males will be red-green colorblind, on average. (There's a 50% probability that a boy will be colorblind)

Genetics Vocabulary

Allele — alternative forms of a gene for each variation of a trait of an organism
Dominant — observed trait of an organism that hides the recessive form of a trait
Recessive — trait of an organism that can be masked by the dominant form of a trait
Trait — characteristic that is inherited; can be either dominant or recessive
Genotype — combination of genes in an organism
Phenotype — outward appearance of an organism, regardless of its genes
Heterozygous — when there are two different alleles for a trait
Homozygous — when there are two identical alleles for a trait
Cross- mate a female with a male

Exercises

1. Women have sex chromosomes of **XX**, and men have sex chromosomes of **XY**.

Which of a woman's grandparents could not be the source of any of the genes on either of her **X**-chromosomes?

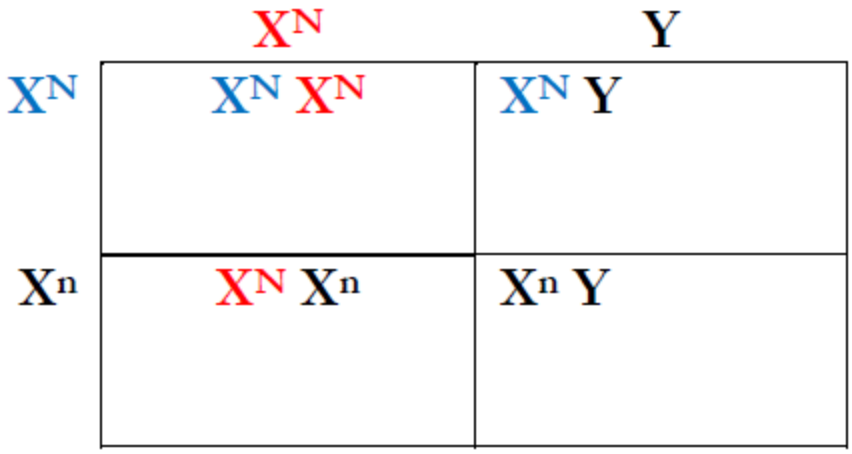
Her paternal grandfather could not be the source of her X chromosome because he only gave the Y to her father. So the X that she inherited form her Dad came from her paternal grandmother.

2. A human female "carrier" who is heterozygous for the recessive, sex-linked trait red color blindness, marries a normal male.

What proportion of their female progeny will show the trait?

Let N = X-linked gene for normal vision

n = X-linked gene for colorblindness



0% of the females will show the trait, but there's a 50% chance that a daughter will be a carrier.

3. In pea plants, spherical seeds (S) are dominant to dented seeds (s). In a genetic cross of two plants that are heterozygous for the seed shape trait, what fraction of the offspring should have spherical seeds?

	S	s
S	S S	S s
s	S s	ss

4/4 = 75% chance of getting a spherical seeded plant

4. Is a phenotypic ratio of 3:1 in the offspring of a mating of two heterozygous organisms for a single trait expected if one gene is dominant over an allelic gene? Show why or why not.

Yes, see above Punnet square for the proof.

5. a) When true-breeding tall stem pea plants are crossed with true-breeding short stem pea plants, if all offspring are tall, then the tall-pea gene is dominant over the short one. True?

True. It's the only way that the short-stem gene would not be expressed. All offspring are Tt.

b) Show what happens when the 2nd generation tall peas are crossed.

	T	t
T	TT	Tt
t	Tt	tt

75% tall; 25% short possibility

6. Two unlinked genes affect mouse hair color. **CC** or **Cc** mice are streaked. Mice with genotype **cc** are albino because all pigment production and deposition of pigment in hair is blocked. At the second location on a different chromosome, the **B** allele (black streaked coat) is dominant to the **b** allele (brown streaked coat). A mouse with a black streaked coat is mated with an albino mouse of genotype **bbcc**. Half of the offspring are albino, one quarter are black-streaked, and one quarter are brown-streaked. What is the genotype of the black streaked parent?
(Hint: first list all four combinations , and then figure out which of the four will give the listed results)

Some of the babies are black streaked(B) and since one of their parents was bbcc, the B must have come from the other parent. Also some babies are not albino, so the other parent also gave them a C for some pigment.

We start with all the possibilities that would have at least one B and at least one C:

1. **BbCc**
2. **BBCC**
3. **BbCC**
4. **BBCc**

Final answer Of these four, only (1) = BbCc can also pass on the albino gene(c) and the (b) that some babies have.

More Protein Synthesis

mRNA codes

First Letter	Second Letter U	Second Letter C	Second Letter A	Second Letter G	Third Letter
U	phenylalanine	serine	tyrosine	cysteine	U
	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	stop	stop	A
	leucine	serine	stop	tryptophan	G
C	leucine	proline	histidine	arginine	U
	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
A	isoleucine	threonine	asparagine	serine	U
	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	(start) methionine	threonine	lysine	arginine	G
G	valine	alanine	aspartate	glycine	U
	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G

7. In Huntington's disease (which impairs coordination, reasoning and emotions), the responsible and dominant gene is longer than the normal one. Specifically, the DNA-sequence GTC is repeated about 40 times, about 23 more than what normally occurs.

   After translation, the protein produced has too many of the same amino acid in its sequence.

   a) What amino acid is being repeated?

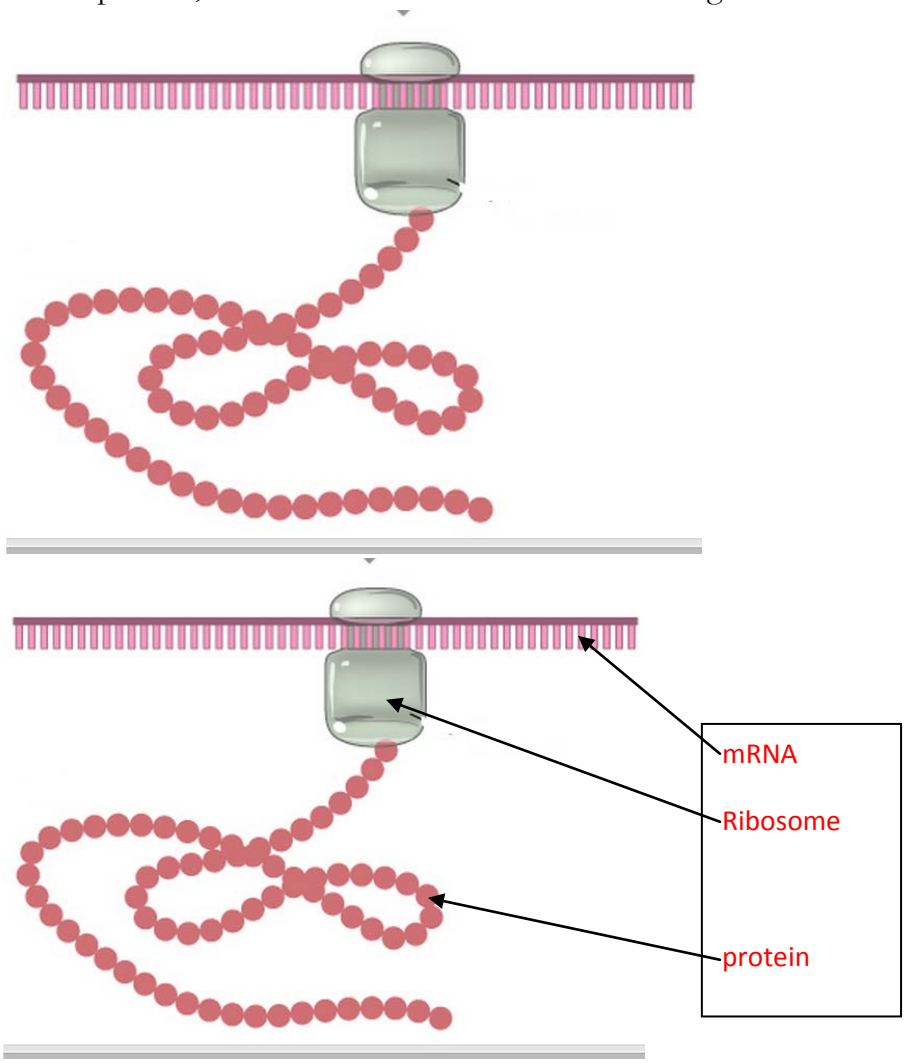
   First we have to get the mRNA sequence from the DNA code:

   GTC in DNA = CAG in mRNA, so the amino acid from the table is glutamine

b) What three bases would be found on the transfer RNA molecule fetching the above amino acid?
GUC

8. Give two different DNA sequences that signal the end of a particular protein mole.
Since the STOP signals from the mRNA code are UAA, UAG and UGA, the corresponding DNA codes would be ATT, ATC and ACT.

9. Label the protein, ribosome and mRNA in the following:



10. On average, every day, an adult produces 1.3 g of protein per kg of body weight. If the average molar mass of human protein is 53 000 g/mole, how many molecules of protein are produced per second in a 100 kg man? *Respect sig figs and your grandmother.*

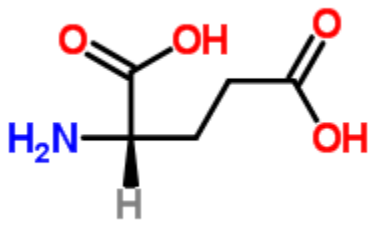
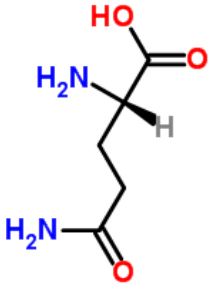
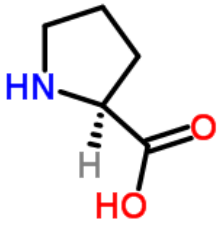
100 kg * 1.3g/kg = 130 g of protein per day

130 g of protein per day (mole/53 000g) = 0.00245283018867924528301886792453 moles per day

0.00245283018867924528301886792453 mole/day (day/24 h) (h/3600s) = 2.83892382948986722571628232005 59 X 10^{-8} moles/s

2.83892382948986722571628232005 59 X 10^{-8} moles/s * 6.022 X 10^{23} molecules/mole = 1.7 X 10^{16} molecules of protein per second!

11. For each amino acid, use the molecular formula and skeleton structure to draw the missing atoms and bonds.

a)	b)	c)
		
Glutamic acid(Glu) $C_5H_9NO_4$	Glutamine(Gln) $C_5H_{10}N_2O_3$	Proline (Pro) $C_5H_9NO_2$