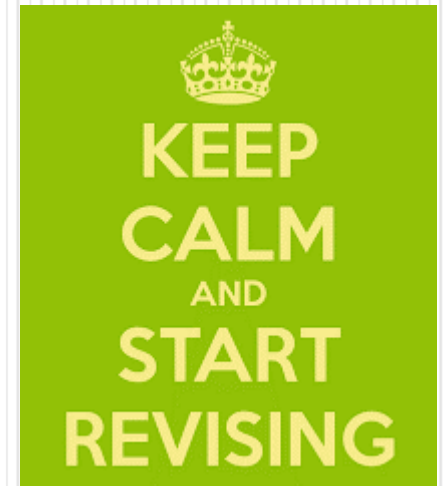


# Revision Mid tri test

Class 11

SLE254 Genetics and Genomics  
Concepts of Genetics (12<sup>th</sup> ed)

**I** ❤️  
**REVISION**



# SLE254 Mid-semester class test 1

- Online test
- Opens at 9AM on the 7th of August
- Closes at 9AM on the 8th of August
- 30 MCA, covers material from week 1- 4
- 50 minutes to complete
- Students can log in any time during that 24hr period
- Once you logged in, you will have to complete the test (time will be ticking away in the background even if you log out)
- You can go back and forth between the questions
- No 9am class on the 10th of August. Students can use the extra hour to study or to complete the test.



# Feeling under pressure and tempted to take short cuts?

- Think again!
- Using gAI and not citing your program, prompt or quality control or gAI quiz breaker is cheating on an MCQ test in SLE254...

However, it's important to understand that ChatGPT or any other AI tool should not replace your own critical thinking and analysis. There are known issues with how up to date and accurate the information provided by AI tools is, and inappropriate use may constitute cheating.

## Guidelines for use

If you want to explore using ChatGPT or other AI tools to assist with your assignments or research, you should:

1. Use AI as a tool to assist you in your research and writing, but not as a replacement for your critical thinking and analysis.
2. Ensure that you [appropriately cite and reference](#) any text or output generated by AI in your assignment, along with any other sources you use. You should clearly indicate where in your assessment task you have used AI-generated material.
3. Understand the AI tool's limitations and use it in conjunction with other sources to ensure the credibility and reliability of the information you present. You need to check the accuracy of all information generated by AI tools.
4. Be aware of the University's [student academic integrity policy](#) and ensure that you follow it.
5. Make sure that the final product is your own work, and not just copied from an AI generator. You can use the generated text as a prompt for inspiration or guidance, but the final submitted assessment must be your work, creation, and analysis.

By following these guidelines, you can use generative AI as a valuable tool to assist you in your research and writing. Understanding how to use these tools correctly is essential to avoiding breaches that could impact your successful course progression and possibly even your graduation.

For more information, visit the [Academic Integrity webpage](#).

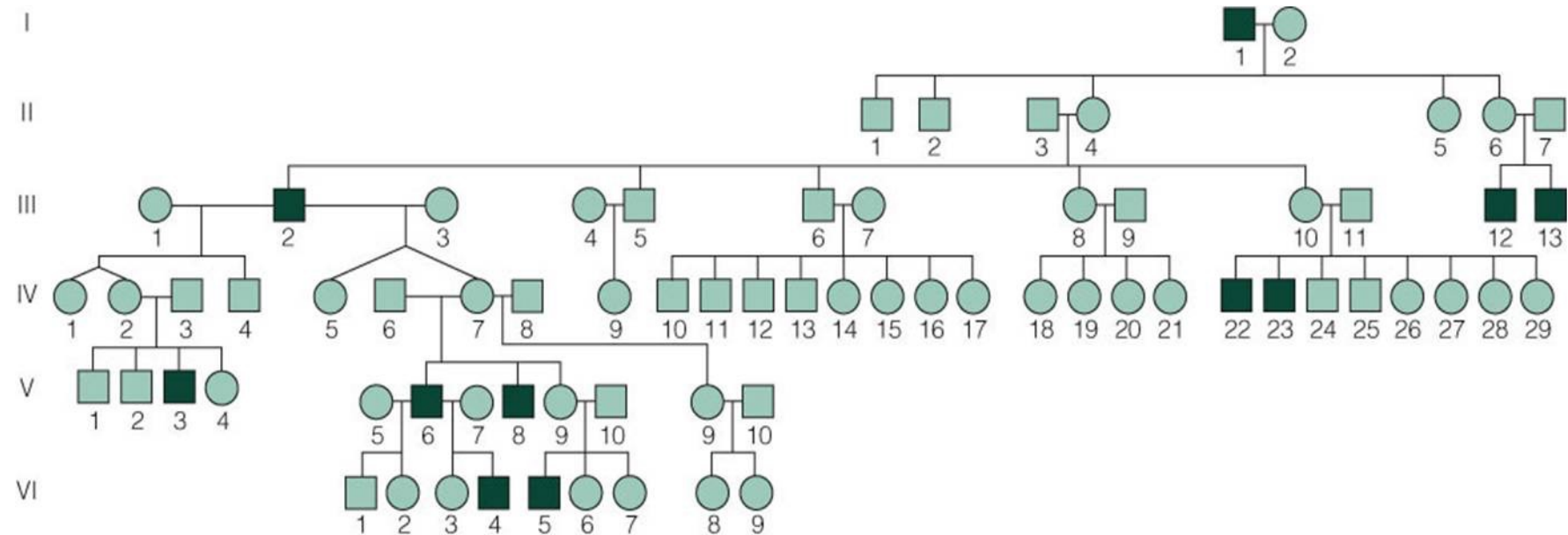
# The mid-tri test



## TIPS

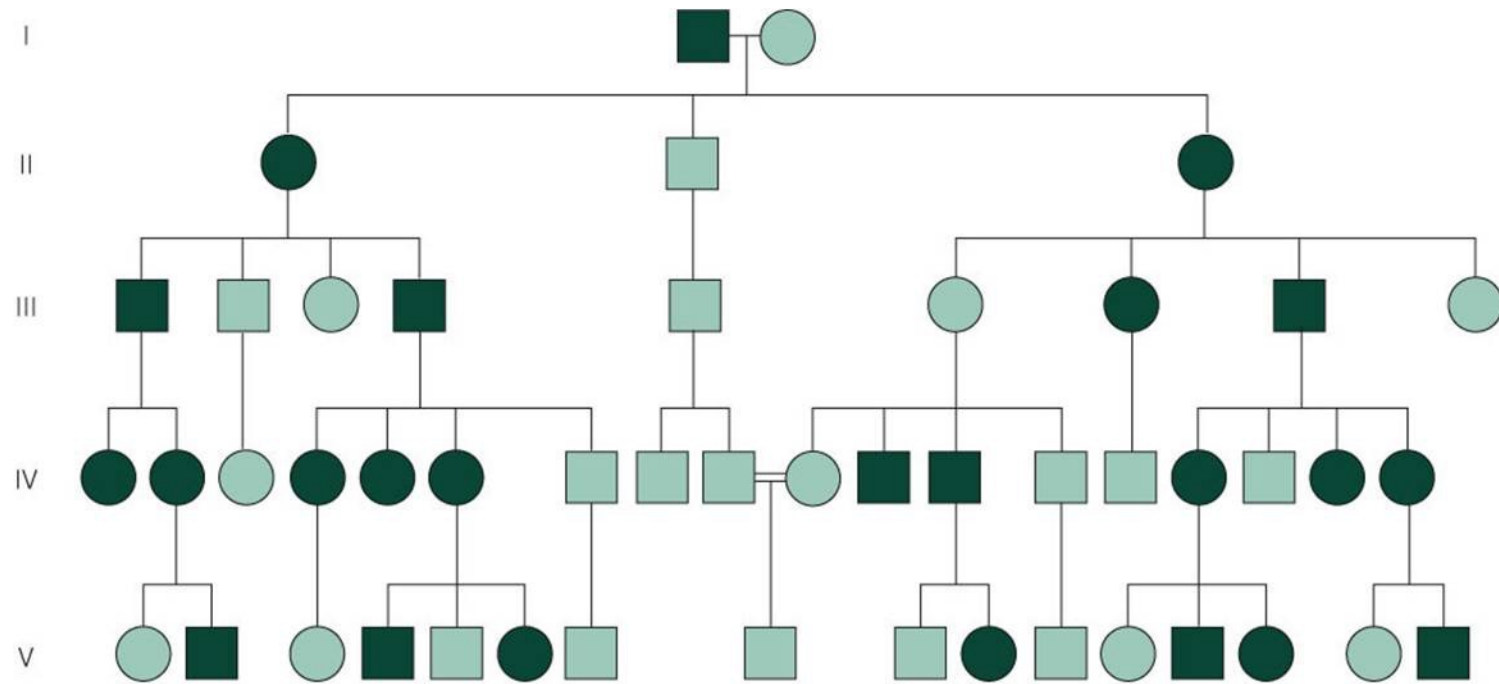
1. Chi square problems: get your punnett squares ready- work out genotypes based on the progeny ratios
2. Get your chi square obs/exp table ready
3. Be ready for the Binomial equation. You will be given all the information you need
4. Get a Punnett square ready for a dihybrid cross

# X-linked recessive pedigree



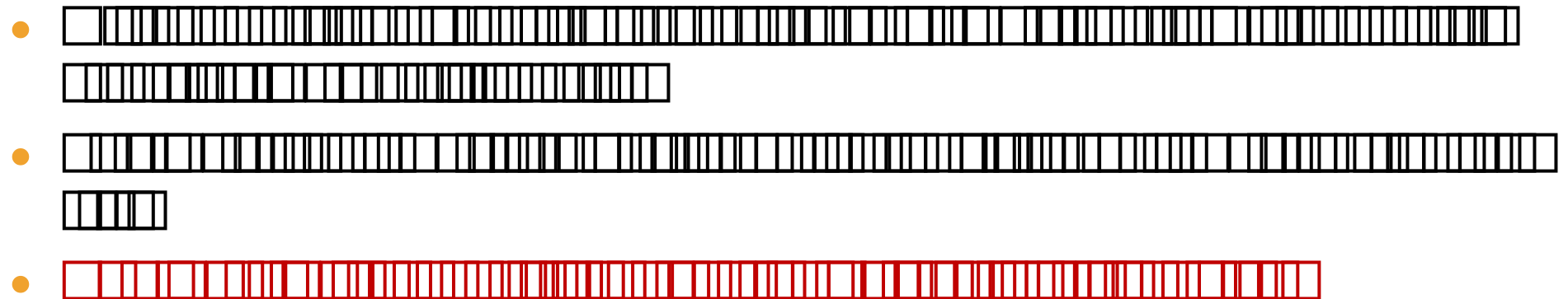
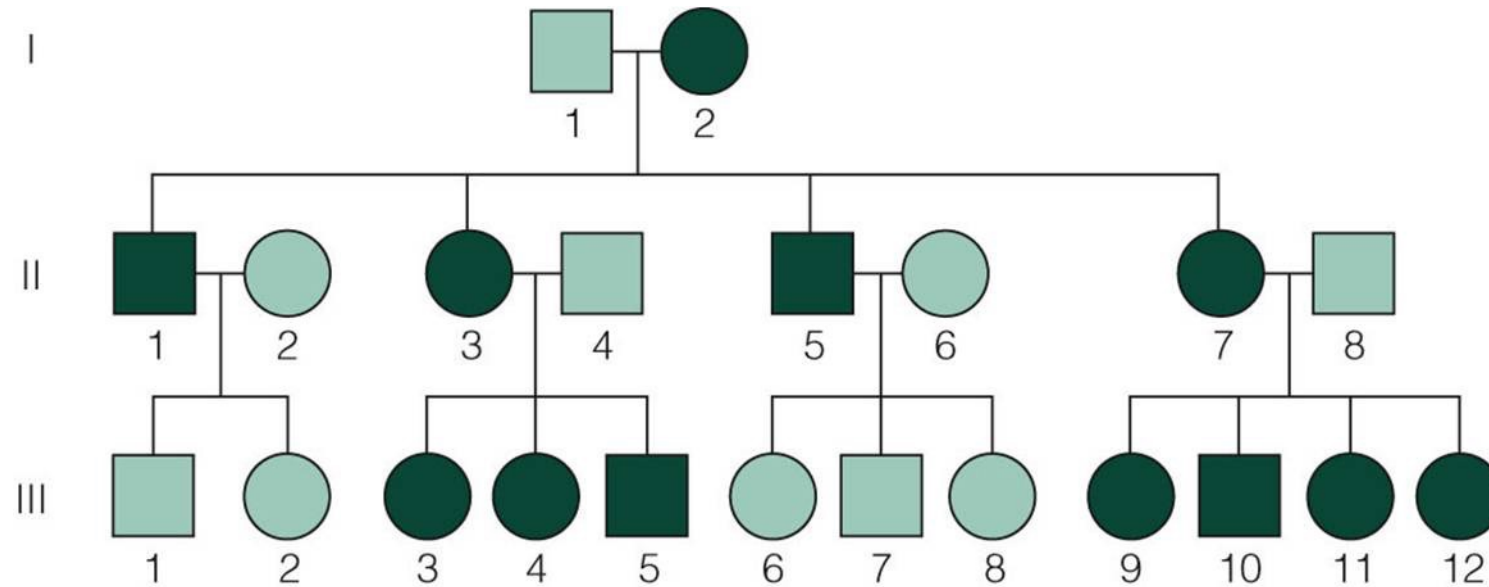
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# X-linked dominant pedigree

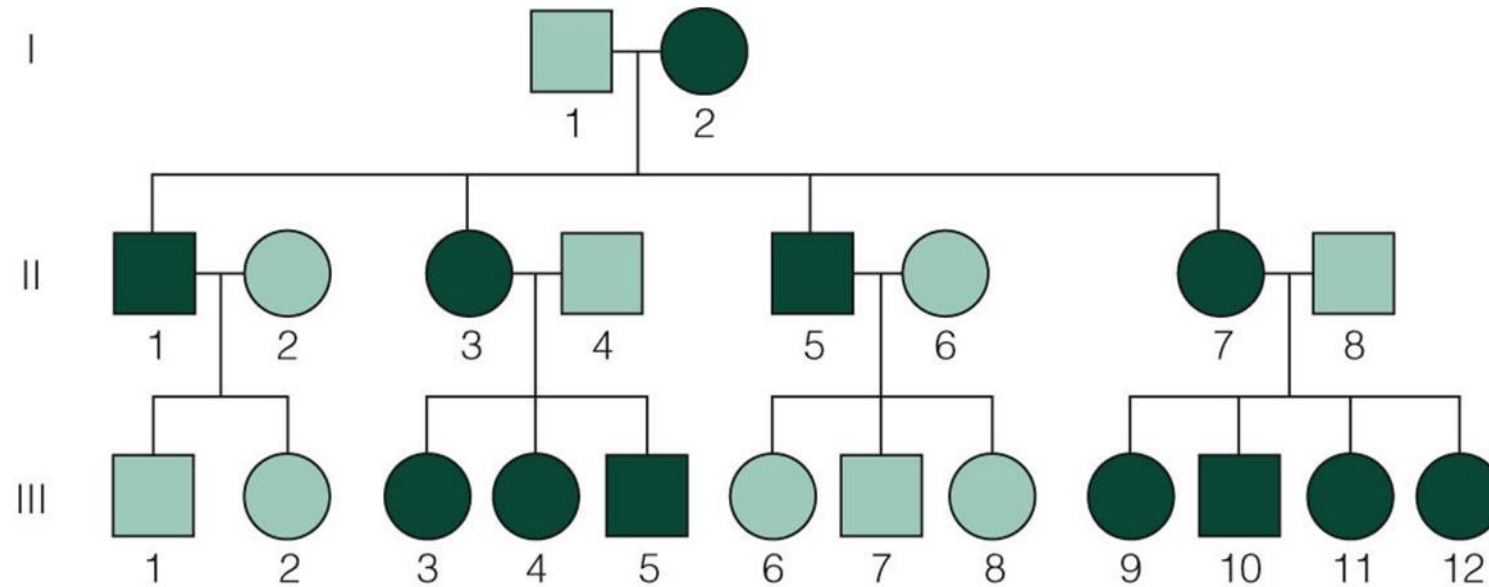





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# Mitochondrial gene pedigree



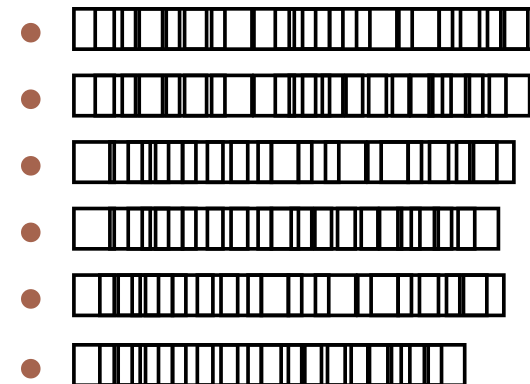
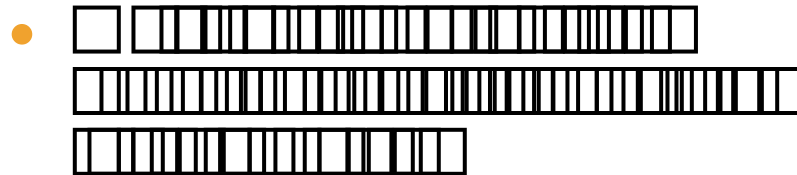
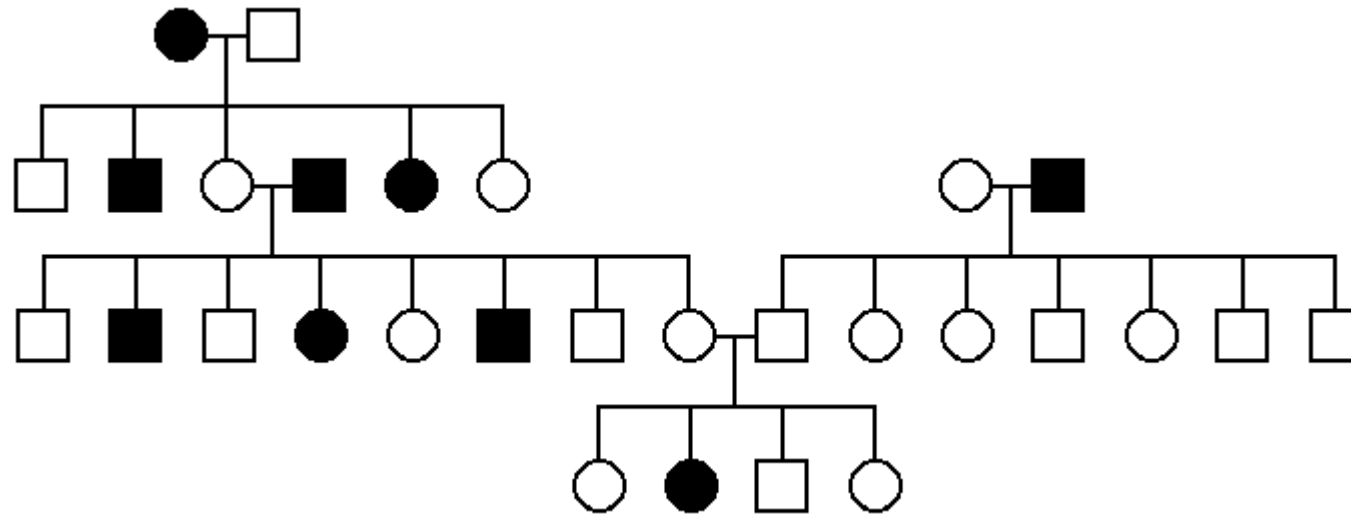
# Mitochondrial gene pedigree



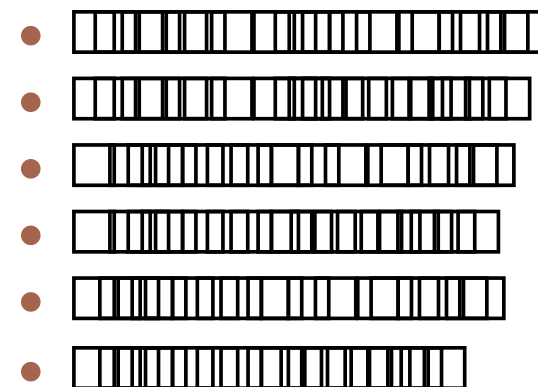
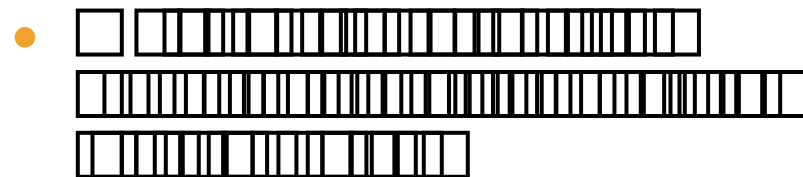
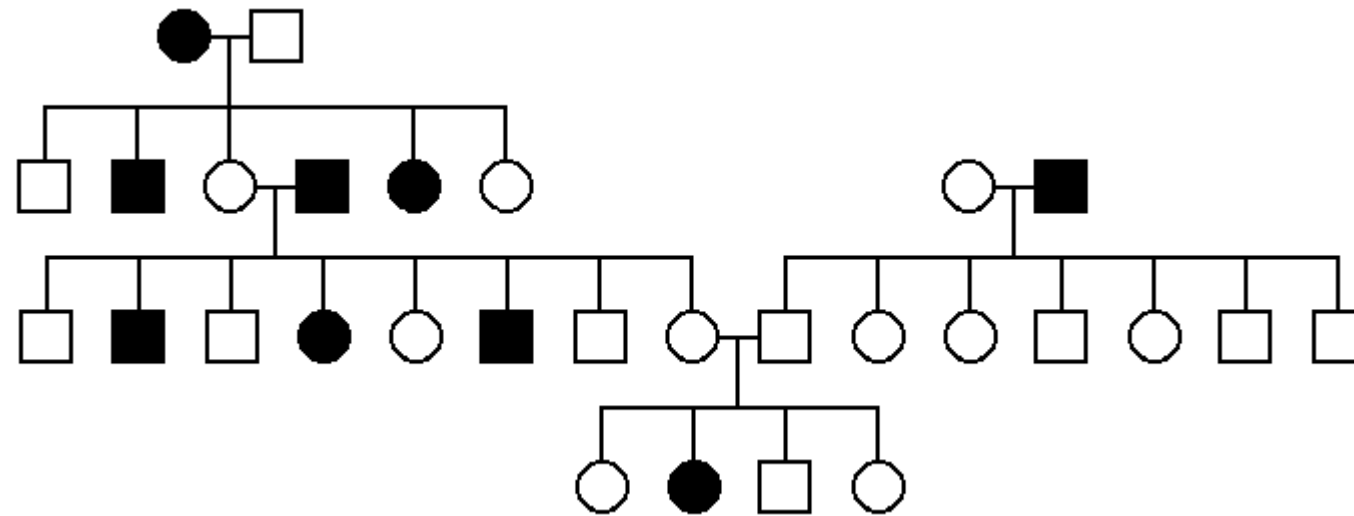
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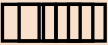
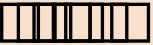




















# Now try these



## Now try these



Questions below are all based on the information provided below:  
 Assume that you have a garden and in that garden some pea plants have solid leaves and others have striped leaves. You conduct a series of crosses [(a) through (e)] and obtain the results given in the table.























cross		progeny	
			
			
			
			
			
			

Based on the observations in the table

- A) Solid is the dominant allele
- B) Striped is the dominant allele
- C) These alleles are codominant
- D) These alleles do not display Mendelian patterns of inheritance























$$\chi^2 = \sum \frac{(o - e)^2}{e}$$

Questions below are all based on the information provided below:  
 Assume that you have a garden and in that garden some pea plants have solid leaves and others have striped leaves. You conduct a series of crosses [(a) through (e)] and obtain the results given in the table.

cross		progeny	
			
			
			
			
			
			

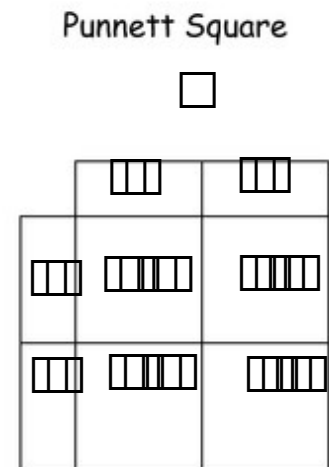
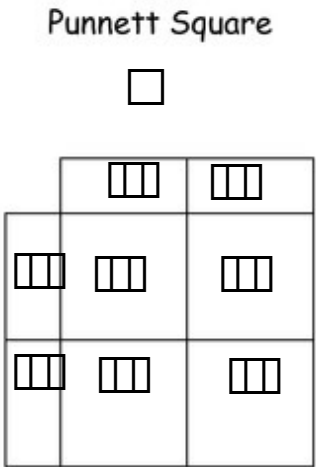
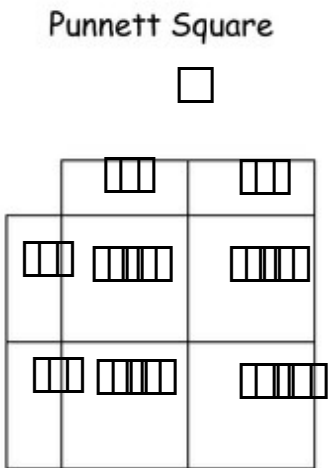
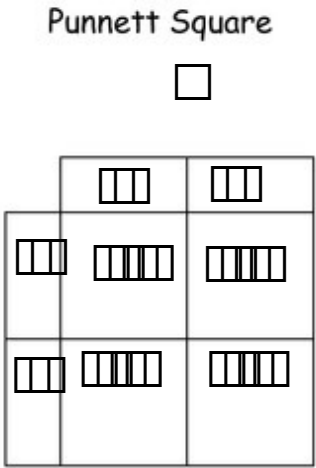
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 Assume that you have a garden and in that garden some pea plants have solid leaves and others have striped leaves. You conduct a series of crosses [(a) through (e)] and obtain the results given in the table.

cross		progeny	
			
			
			
			
			
			























$$\chi^2 = \sum \frac{(o - e)^2}{e}$$

**MONOHYBRID CROSS**  
**st = striped**  
**so= solid**  
**You can use:**  
**S= striped s= solid**



If you were to conduct a chi square test on some of the crosses from this data set the expected ratios for cross (c) would be:























- A. 3 solid: 1 striped
- B. 1 solid: 1 striped
- C. 4 solid: 0 striped
- D. 3 striped: 1 solid


























cross		progeny	
			
			
			
			
			
			

Using the formula below the table, the critical chi square value for data obtained from cross (c) would be (NOTE all values were rounded to 4 significant figures for this calculation):

- A. 0.98
- B. 97.00
- C. 102.2
- D. 0.3846

$$\chi^2 = \sum \frac{(o - e)^2}{e}$$

cross		progeny	
			
			
			
			
			
			

Your chi square value is:  $0.0962 + 0.2885 = 0.3846$

Your df = 1

Critical chi square value at  $p = 0.05$  is 3.84

Your chi square value is < than the critical chi square value

	Probability (p)					
	0.90	0.50	0.20	0.05	0.01	0.001
1	0.02	0.46	1.64	3.84	6.64	10.83
2	0.21	1.39	3.22	5.99	9.21	13.82
3	0.58	2.37	4.64	7.82	11.35	16.27
4	1.06	3.36	5.99	9.49	13.28	18.47
5	1.61	4.35	7.29	11.07	15.09	20.52
6	2.20	5.35	8.56	12.59	16.81	22.46
7	2.83	6.35	9.80	14.07	18.48	24.32
8	3.49	7.34	11.03	15.51	20.09	26.13
9	4.17	8.34	12.24	16.92	21.67	27.88
10	4.87	9.34	13.44	18.31	23.21	29.59
15	8.55	14.34	19.31	25.00	30.58	37.30
25	16.47	24.34	30.68	37.65	44.31	52.62
50	37.69	49.34	58.16	67.51	76.15	86.60

$\chi^2$  values

By comparing the chi square value you calculated to the critical chi square value table above, which statement would be true in its entirety?

- A) The chi square value is less than the critical chi square value and therefore you **accept** the null hypothesis and any differences between observed and expected numbers are due to chance.
- B) The chi square value is less than the critical chi square value and therefore you **accept** the null hypothesis and any differences between observed and expected numbers are **NOT** due to chance.
- C) The chi square value is less than the critical chi square value and therefore you **reject** the null hypothesis and any differences between observed and expected numbers are due to chance.
- D) The chi square value is less than the critical chi square value and therefore you **reject** the null hypothesis and any differences between observed and expected are **NOT** due to chance.



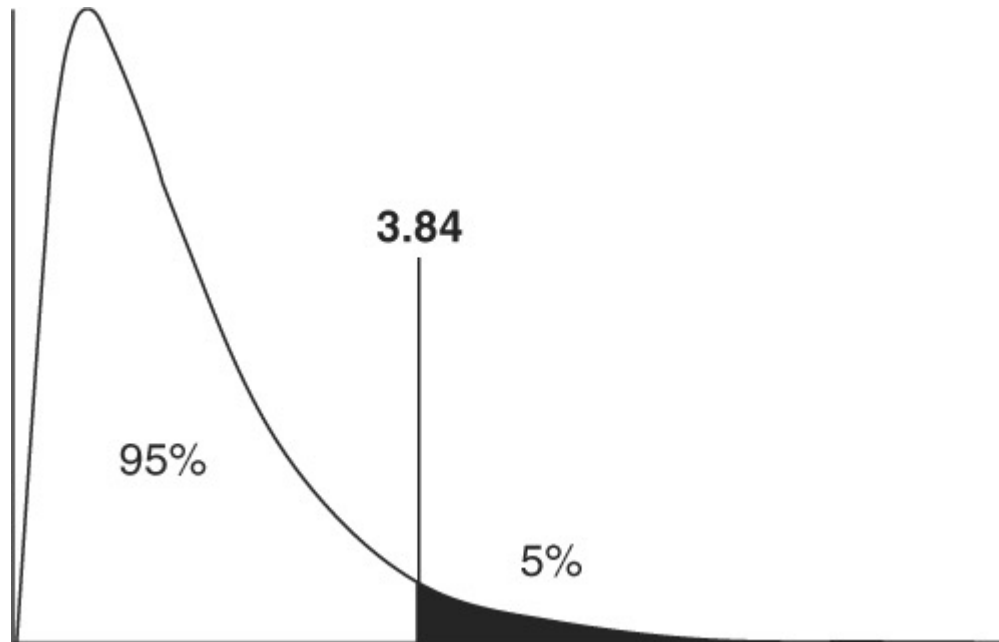
## WHAT IS THE CHI SQUARE PROBABILITY TABLE TELLING ME?



Your chi square value is:  $0.0962 + 0.2885 = \mathbf{0.3846}$ , Your df = 1

Chi Square distribution 1 df

Critical chi square value at  $p = 0.05$  is **3.84**



**<3.84 Accept Null Hypothesis** **=>3.84 Reject Null Hypothesis**

**Probability that you would get your  $\chi^2$  value if the null hypothesis was true is <5%**

	Probability (p)					
	0.90	0.50	0.20	0.05	0.01	0.001
1	0.02	0.46	1.64	3.84	6.64	10.83
2	0.21	1.39	3.22	5.99	9.21	13.82
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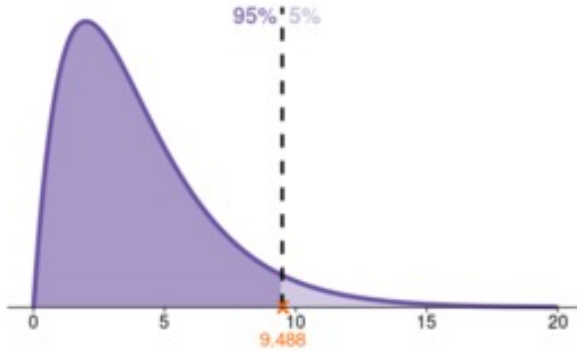
$\chi^2$  values

Your chi square value is < than the critical chi square value

Explore Find Percentile Find Probability

Chi-Squared Distribution with df = 4

$P(X < 9.488) = 95\%$



The probability distribution varies with the df

the degrees of freedom are number of classes -1

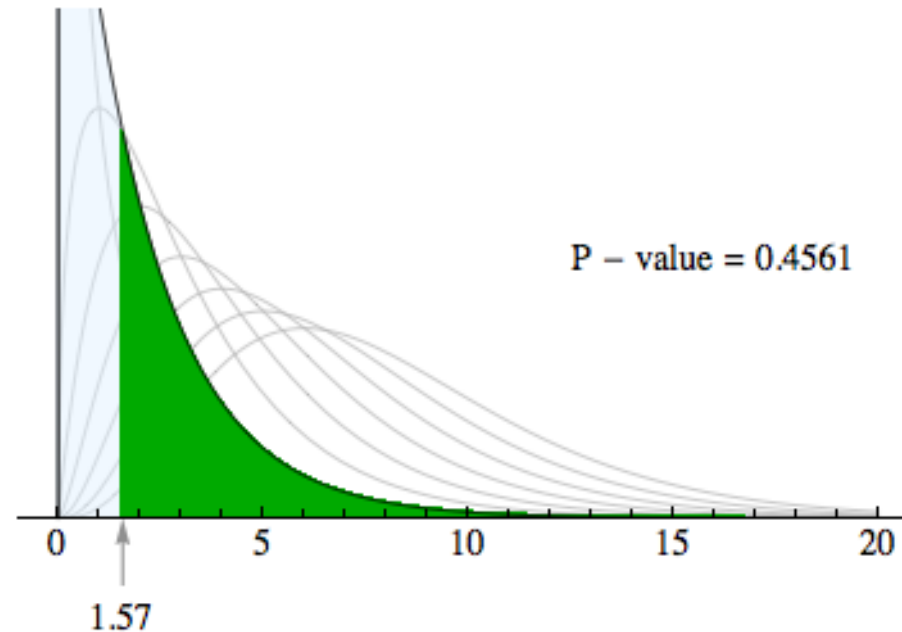
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25	16.47	24.34	30.68	37.65	44.31	52.62
50	37.69	49.34	58.16	67.51	76.15	86.60

$\chi^2$  values

degrees of freedom =

1 2 3 4 5 6 7 8



# Practice Test - Answers

1. At which stage of mitosis are chromosomes usually photographed in the preparation of a karyotype?

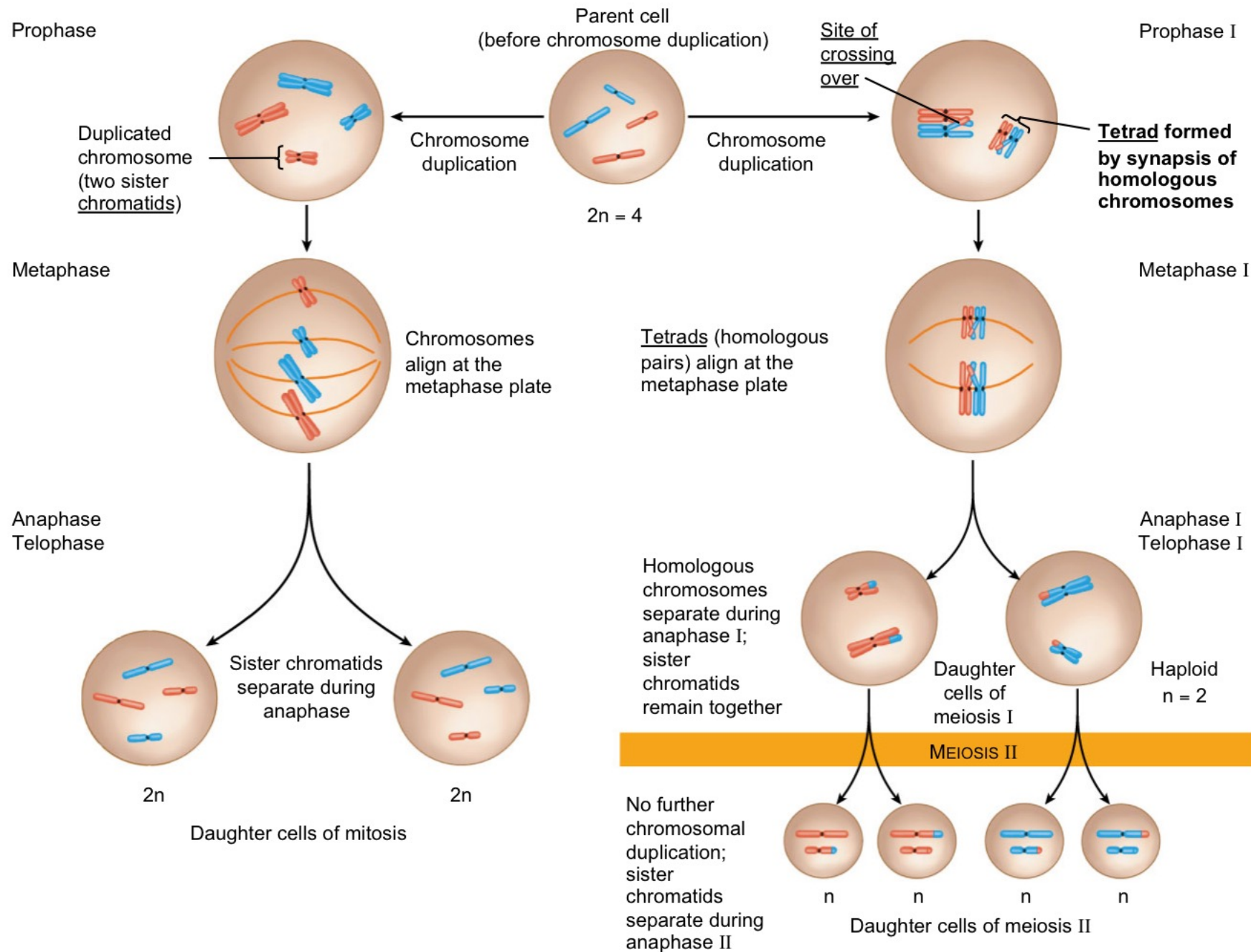
- A) prophase
- B) metaphase
- C) anaphase
- D) interphase

2. A triploid cell contains sets of three homologous chromosomes. If a cell of a usually diploid species with 42 chromosomes is triploid, this cell would expect to have which of the following?

- A) 63 chromosomes in 31 & 1/2 pairs
- B) 14 chromosomes, each with three chromatids
- C) 21 chromosomes pairs and 21 unique chromosomes
- D) 63 chromosomes in 3 sets of 21

3. How do cells at the completion of meiosis compare with cells that are in prophase of meiosis 1? They have\_\_\_\_\_.

- A) half the number of chromosomes and half the amount of DNA.
- B) the same number of chromosomes and half the amount of DNA.
- C) half the amount of cytoplasm and twice the amount of DNA.
- D) half the number of chromosomes and one-fourth the amount of DNA.



4. What following statement is the most correct about Heterochromatin?

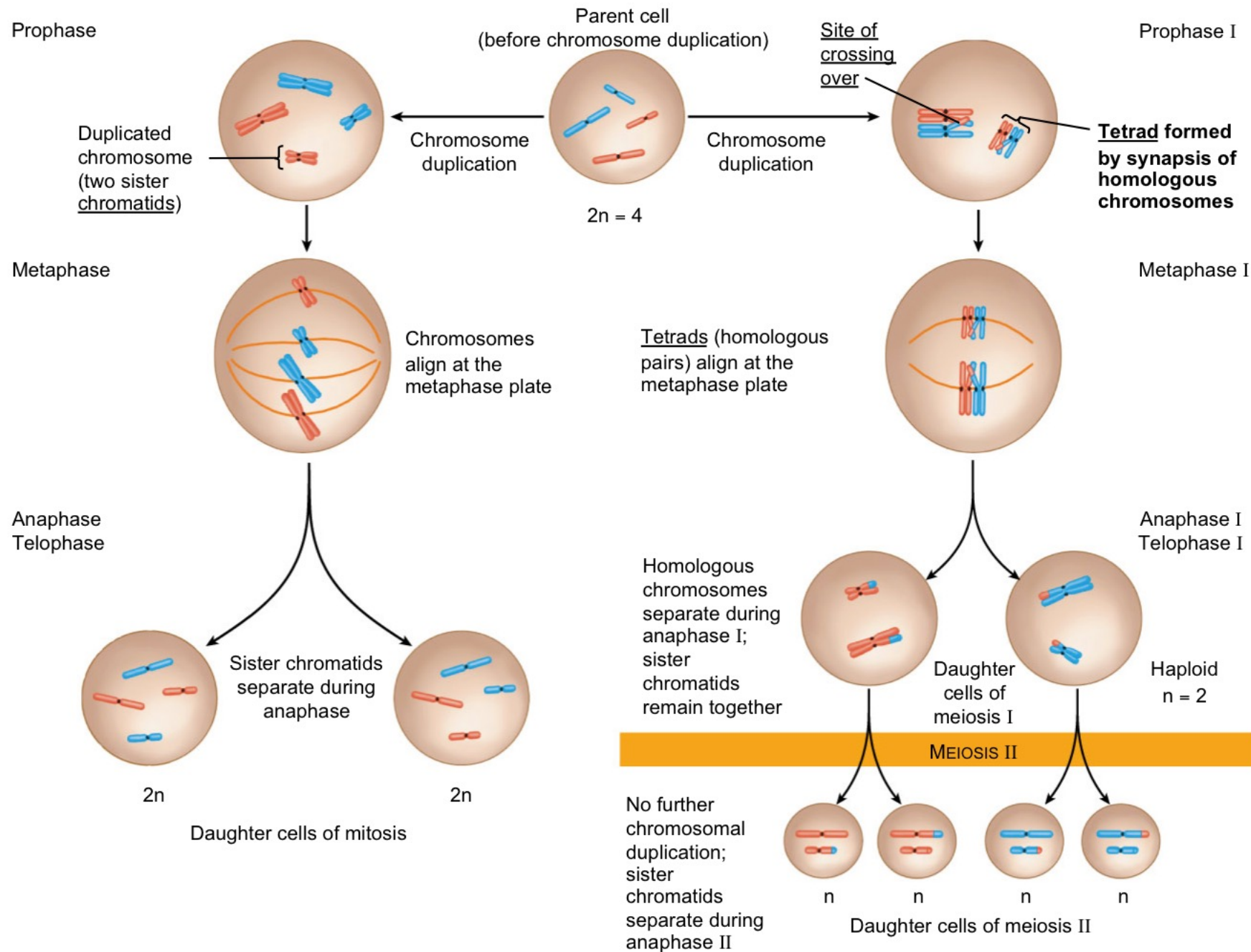
- A) tightly packed DNA that facilitates transcription during cellular mitosis.
- B) loosely packed DNA that allows for transcription during cellular interphase.
- C) only occurs during mitosis and facilitates transcription.
- D) areas of DNA that stain with Giemsa the most in karyotyping.

5. What is a major difference between mitosis and meiosis 1 in a diploid organism?

- A) Sister chromatids separate in mitosis, while homologous pairs of chromosomes separate in meiosis I.
- B) Sister chromatids separate in mitosis, while homologous pairs of chromosomes separate in meiosis II.
- C) DNA replication takes place prior to mitosis, but not before meiosis I.
- D) Only meiosis I results in daughter cells that contain identical genetic information.

Remember (see pic on next slide)





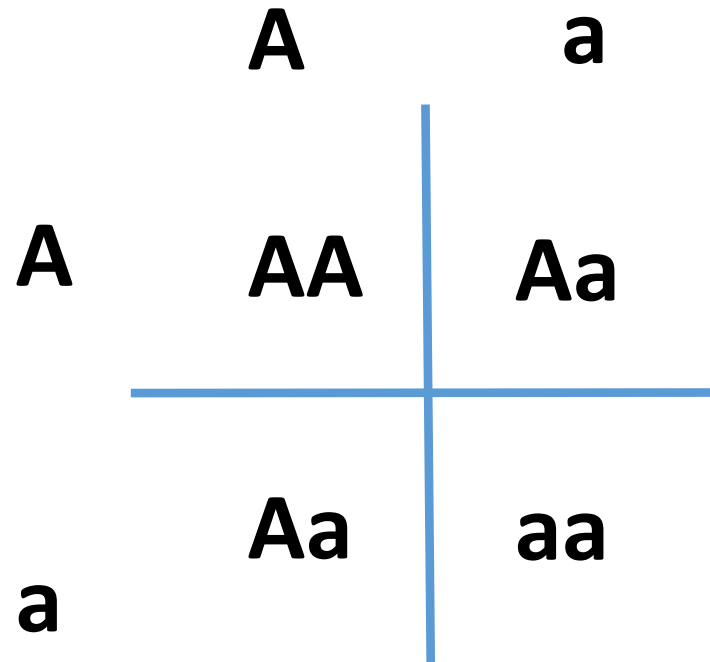
6. If two people who are both heterozygous for Huntington's disease (an autosomal dominant trait) marry, what is the probability that they will have five children, all of which are normal?

A) 0.001

B) 0.125

C) 0.237

D) 0.016



7. Gregor Mendel performed a dihybrid cross between two traits in the pea plant; seed colour and seed shape. Yellow (Y) was dominant to green (g) and round (R) was dominant to wrinkled (w). If Mendel crossed two plants that were both heterozygous for both traits (YgRw), what is the probability of getting the following all-dominant genotype 'YYRR'?

**YgRw X YgRw**

- A) 1/2.
- B) 1/4.
- C) 1/8.
- D) 1/16.

	YR	Yw	gR	gw
YR	YYRR	YYRw	YgRR	YgRw
Yw	YYRw	YYww	YgRw	Ygww
gR	YgRR	YgRw	ggRR	ggRw
gw	YgRw	Ygww	ggRw	ggww

8. Gregor Mendel performed a dihybrid cross between two traits in the pea plant; seed colour and seed shape. Yellow (Y) was dominant to green (g) and round (R) was dominant to wrinkled (w). If Mendel crossed two plants that were both heterozygous for both traits (YgRw), what is the probability of getting either the all-dominant genotype 'YYRR' **or** the all-recessive genotype 'ggww'?

**YgRw X YgRw**

- A) 1/32.
- B) 1/4.
- C) 1/8.
- D) 1/16.

	YR	Yw	gR	gw
YR	YYRR	YYRw	YgRR	YgRw
Yw	YYRw	YYww	YgRw	Ygww
gR	YgRR	YgRw	ggRR	ggRw
gw	YgRw	Ygww	ggRw	ggww

Mutually exclusive = what rule?

$$1/16 + 1/16 = 2/16 = 1/8$$

9. Independent assortment of chromosomes is a result of \_\_\_\_\_?

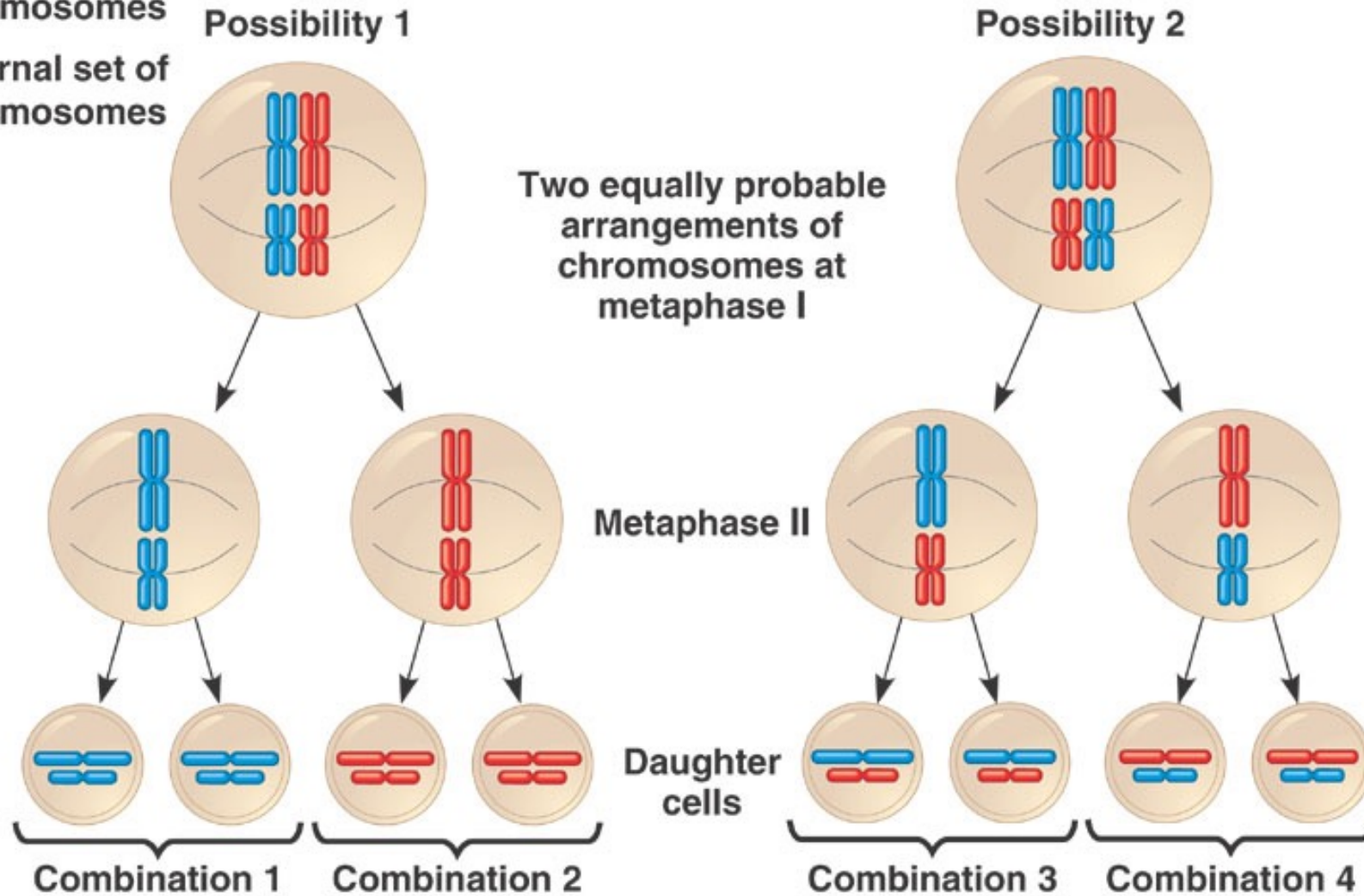
- A) the random way each pair of homologous chromosomes lines up at the metaphase plate during meiosis I.
- B) the random combinations of eggs and sperm during fertilisation.
- C) the random distribution of the sister chromatids to the two daughter cells during anaphase II.
- D) the diverse combination of alleles that may be found within any given chromosome.

Remember (see pic on next slide)

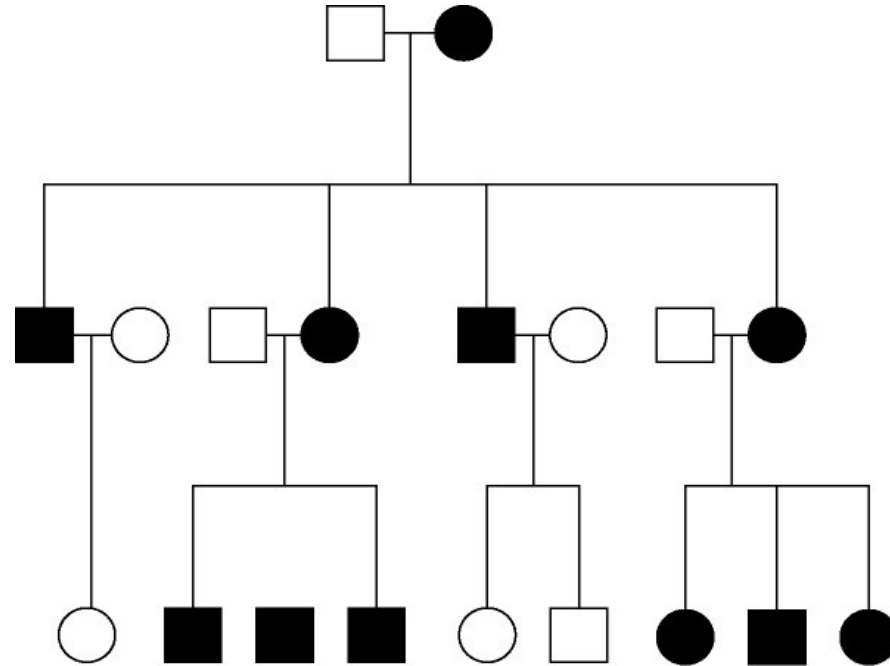
### Key

■ Maternal set of chromosomes

■ Paternal set of chromosomes



10. The pedigree in the figure below shows the transmission of a trait in a particular family. Based on this pattern of transmission, the trait is most likely \_\_\_\_\_?



- A) mitochondrial
- B) sex-linked dominant
- C) sex-linked recessive
- D) autosomal dominant

11. The epistatic allele for the white colouration of squash is represented by a W. The hypostatic allele for green colouration is represented by a G. When squash has all recessive alleles for colouration (wwgg) they are yellow. What is the probability that when a green squash (wwGg) is crossed with a white squash (Wwgg) the offspring are green (wwGg or wwGG)?

**wwGg X Wwgg**

A) 0.

B) 1/4.

C) 1/2.

D) 3/16

	wG	wg	wG	wg
Wg	WwGg	Wwgg	WwGg	Wwgg
Wg	WwGg	Wwgg	WwGg	Wwgg
wg	wwGg	wwgg	wwGg	wwgg
wg	wwGg	wwgg	wwGg	wwgg



12. The Bombay genotype (mutant *FUT1* gene) prevents the synthesis of the H substance and consequently red blood cells cannot produce functional A and B antigens. If mum had the genotype  $I^A I^A$  and dad had  $I^B I^O$ , and dad has the Bombay phenotype, what blood groups do the parents have?

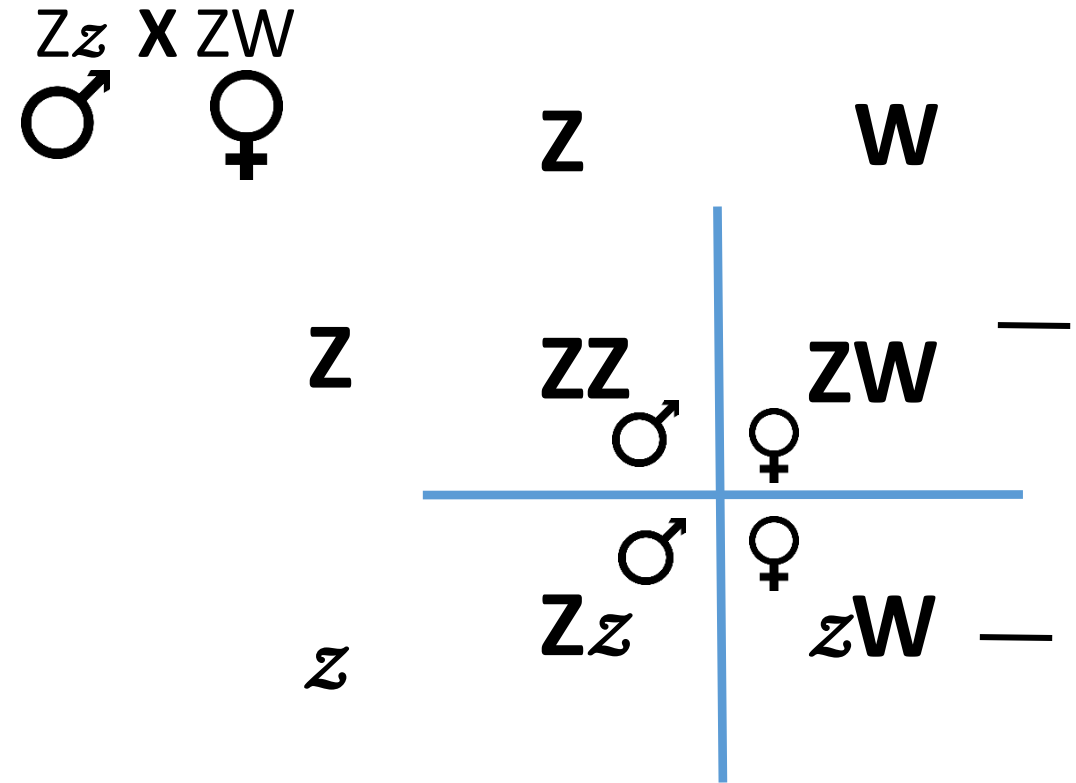
- A) mum has O, while dad has B.
- B) mum has A, while dad has O.
- C) mum has A, while dad has B.
- D) both parents have O.

13. A red flower with the genotype ( $C^R C^R$ ) crosses with a white flower with the genotype ( $C^W C^W$ ) and produces a pink flower with the genotype ( $C^R C^W$ ). This exception to Mendelian genetics can be account for by \_\_\_\_\_?

- A) codominance.
- B) gene linkage.
- C) multiple alleles.
- D) incomplete dominance.

14. A recessive lethal allele that causes death of the embryo is sometimes present on the Z chromosome in pigeons. What would the sex ratio be in the living offspring of a cross between a male that is heterozygous for the lethal allele and a normal female?

- A) 2:1 male to female
- B) 1:2 male to female
- C) 1:1 male to female
- D) 3:1 male to female



15. Complete the sentence: two or more genes located on the same chromosome that do not show independent assortment \_\_\_\_\_?

- A) are in incomplete dominance and they are inherited together.
- B) are called linked genes where they are not inherited together.
- C) are called linked genes that tend to be inherited together.
- D) are in incomplete dominance and they are not inherited together.

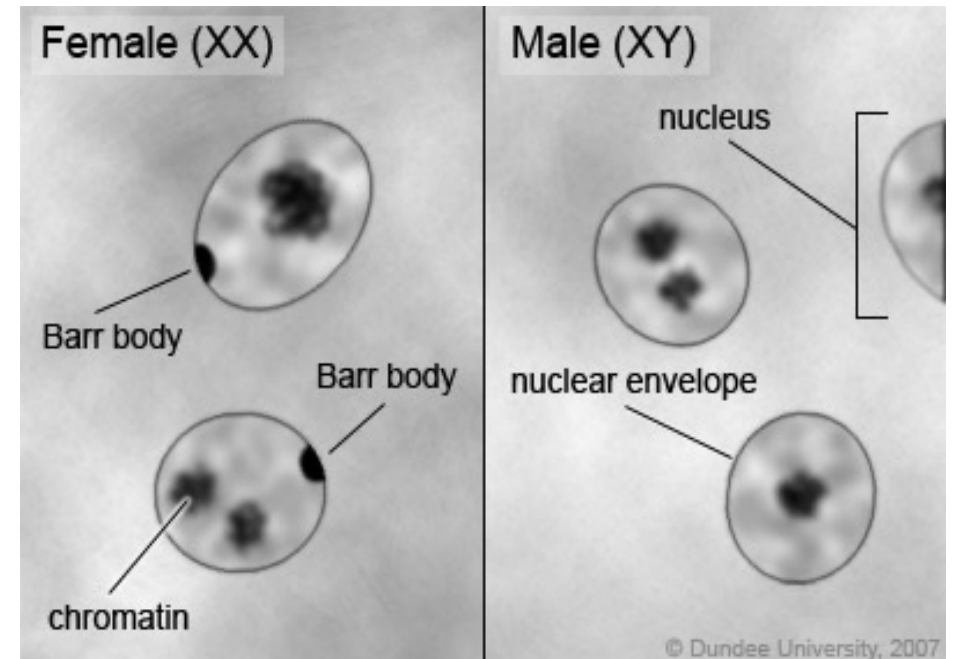
16. Human females have two X chromosomes in all somatic cells and regulate the expression of sex-linked genes through X-linked inactivation. Every X-chromosome that is inactivated forms a Barr body within the nucleus as shown in the figure below. If a Male has the following genotype with regards to his X-chromosomes (48,XXXY), how many Barr bodies form in each nucleus?

- A) 3.
- B) 2.
- C) 1.
- D) none, X-inactivation only occurs in females.


Remember only 1 X-chromosome is required  
and all others become Barr bodies

~~X~~ ~~X~~ X Y  
↑    ↑

These become Barr bodies



17. If cell X enters meiosis, and nondisjunction of one chromosome occurs in one of its daughter cells during meiosis II, what will be the result at the completion of meiosis?

- A) All the gametes descended from cell X will be diploid.
- B) Half of the gametes descended from cell X will be  $n + 1$ , and half will be  $n - 1$ .
-  C) 1/4 of the gametes descended from cell X will be  $n + 1$ , 1/4 will be  $n - 1$ , and 1/2 will be  $n$ .
- D) Two of the four gametes descended from cell X will be haploid, and two will be diploid.

# Non-disjunction at Meiosis

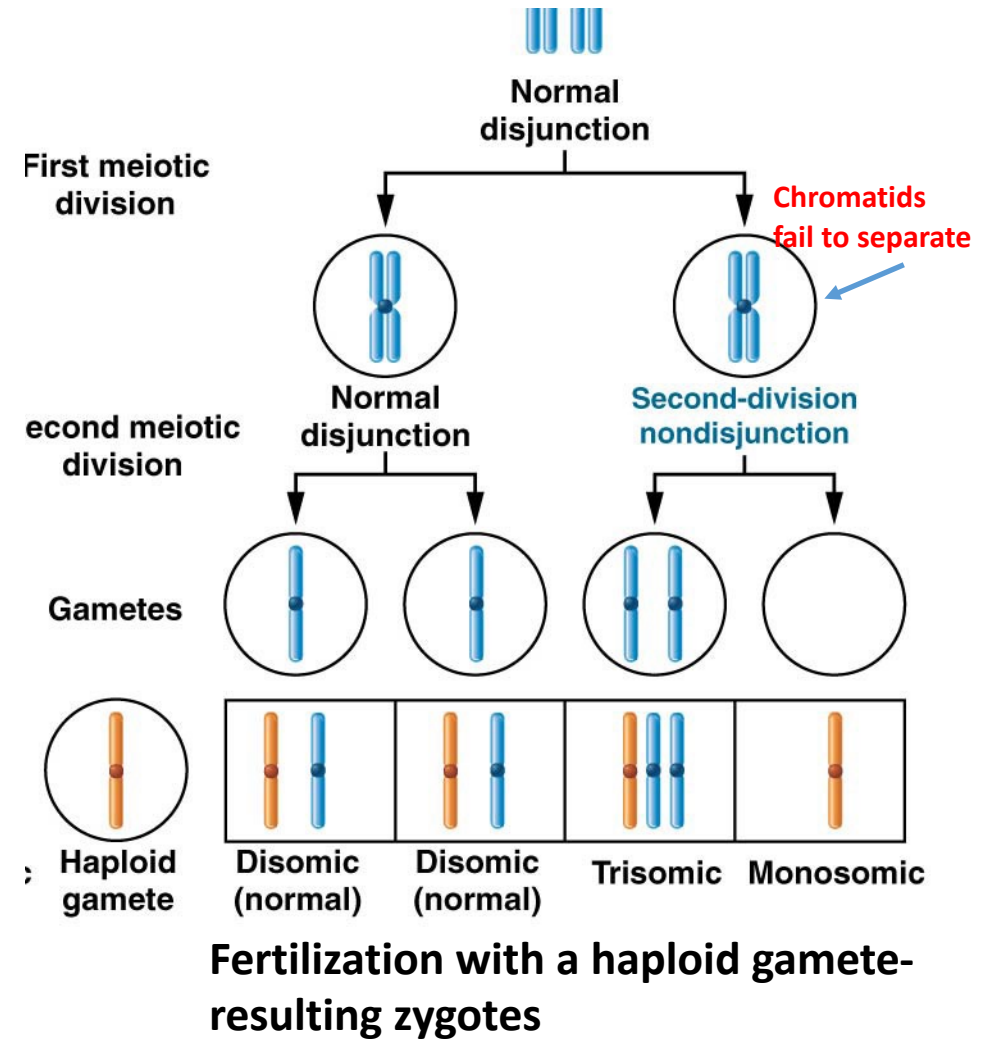


Figure 6.1

18. During meiosis, a defect occurs in a cell that results in the failure of microtubules (spindle fibres) to bind at the kinetochores, a protein structure on chromatids where the spindle fibres attach during cell division to pull sister chromatids apart. Which of the following is the most likely result of such a defect?

- A) New microtubules with more effective binding capabilities to kinetochores will be synthesised to compensate for the defect.
- B) Excessive cell divisions will occur, resulting in cancerous tumours and an increase in the chromosome numbers known as polyploidy.
- C) The defect will be bypassed in order to ensure normal chromosome distribution in the new cells.
- D) The resulting cells will not receive the correct number of chromosomes in the gametes, a condition known as aneuploidy.



19. Monosomy of a chromosome refers to \_\_\_\_\_?

- A) A single chromosome breakage that results in a unique chromosome
- B) A chromosomal number that is a multiple of the normal haploid chromosomal set
- C) A condition in which one member of a chromosomal pair is missing; one less than the diploid number ( $2n - 1$ )
- D) A condition in which one chromosome is present in three copies, and all others are diploid; one more than the diploid number ( $2n + 1$ )

20. Trisomy of a chromosome refers to \_\_\_\_\_?

- A) A single chromosome breakage that results in a unique chromosome
- B) A chromosomal number that is a multiple of the normal haploid chromosomal set
- C) A condition in which one member of a chromosomal pair is missing; one less than the diploid number ( $2n - 1$ )
- D) A condition in which one chromosome is present in three copies, and all others are diploid; one more than the diploid number ( $2n + 1$ )

21. Which of the following is not a purine

A) Adenine

B) Guanine

C) Thymine

D) None are purines

Adenine – Cytosine – Guanine – Thymine/Uracil

**Purine**

**Pyrimidine**

**Purine**

**Pyrimidine**

**Double**

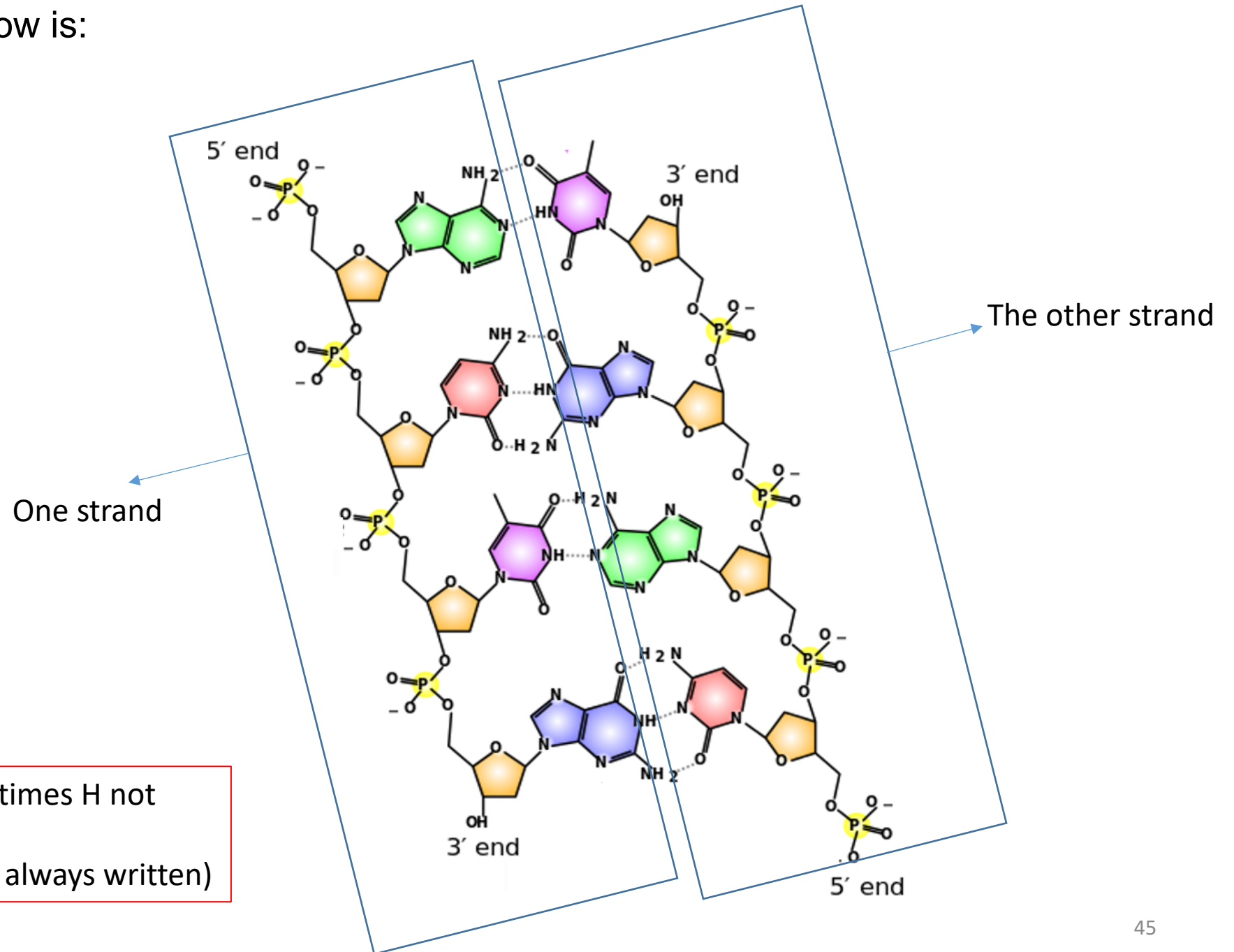
**Single**

**Double**

**Single**

22. The polynucleotide below is:

- A) Single stranded DNA
- B) Double stranded RNA
- C) Double stranded DNA
- D) Single stranded RNA

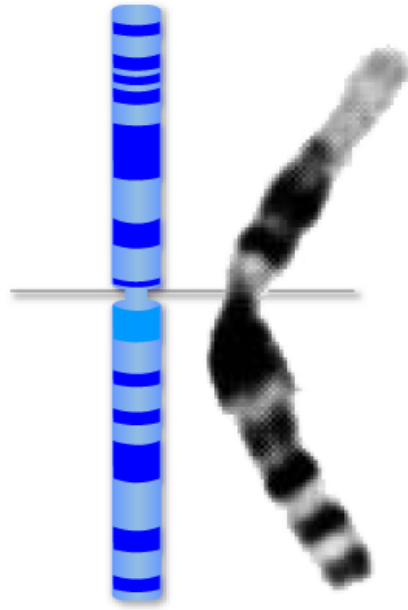


DNA has a 'H' at the (sometimes H not written)  
RNA has an 'OH' (oxygen is always written)

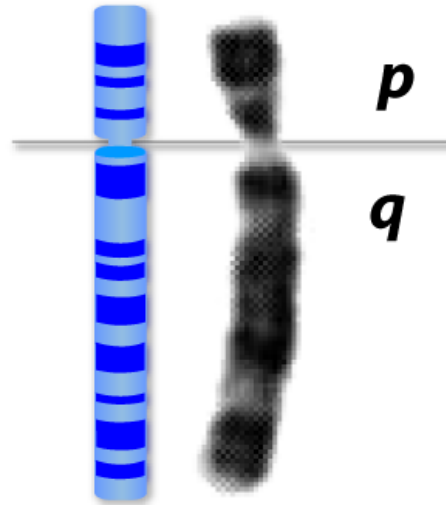
23. The enzyme that releases the tension of supercoiling DNA is:

- A) Polymerase
- B) Topoisomerase
- C) Helicase
- D) Exonuclease

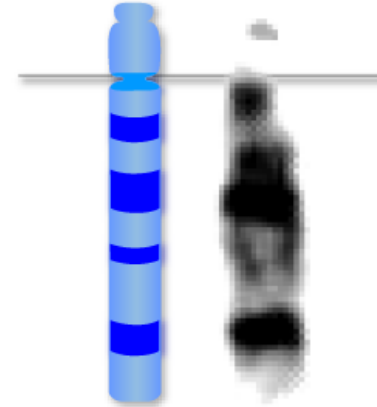
24. The chromosome below is a(n) ..... chromosome:



Chromosome 1  
Metacentric



Chromosome 4  
Submetacentric

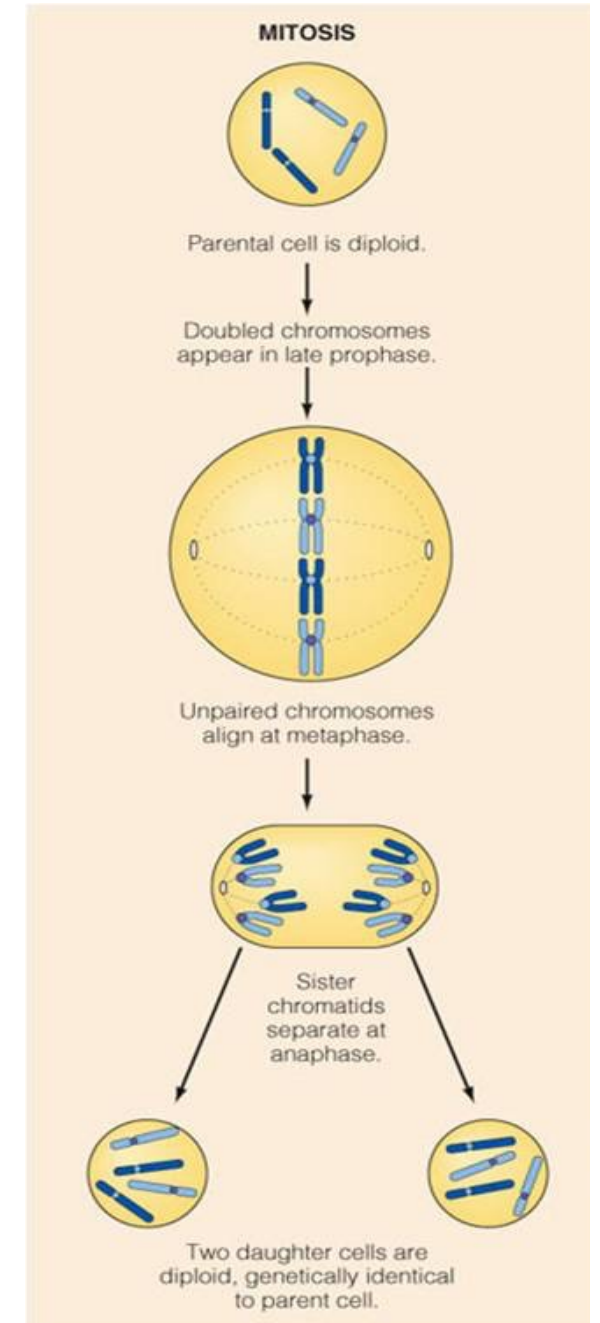


Chromosome 14  
Acrocentric

- A) Acrocentric
- B) Metacentric
- C) Submetacentric
- D) Telocentric

25. How many chromosomes and chromatids are present in the prophase of mitosis in a human somatic cell?

- A) 46 chromosomes, 92 chromatids
- B) 23 chromosomes, 46 chromatids
- C) 92 chromosomes, 46 chromatids
- D) 46 chromosomes, 23 chromatids





Phase (Mitosis)	# Chromosomes	# Chromatids
Prophase	46	92
Metaphase	46	92
Anaphase	92	92
Telophase	92	92
End of Mitosis (separated cells)	46	46
Phase (Meiosis I)	# Chromosomes	# Chromatids
Prophase I	46	92
Metaphase I	46	92
Anaphase I	46	92
Telophase I	46	92
End of Meiosis I (separated cells)	23	46
Phase (Meiosis II)	# Chromosomes	# Chromatids
Prophase II	23	46
Metaphase II	23	46
Anaphase II	46	46
Telophase II	46	46
End of Meiosis II (separated cells)	23	23

<https://datbootcamp.com/biology-strategy/chromosome-and-chromatid-numbers-during-mitosis-and-meiosis/>

26. The Karyotype 46,XY,del(13)(p9) means \_\_\_\_\_?

- A) Female, 46 Chromosomes, deletion of short arm on chromosome 13 at region 9
- B) Male, 46 Chromosomes, deletion of long arm on chromosome 13 at region 9
- C) Female, 46 Chromosomes, deletion of long arm on chromosome 13 at region 9
- D) Male, 46 Chromosomes, deletion of short arm on chromosome 13 at region 9

27. You have to complete a genetics exam but you didn't study at all (How could you? The lecturer makes it so boring!). The proposed exam consists of 20 questions - all multiple choice with 4 options (a, b, c, d). What is the probability that you can pass the genetics exam, score 10/20, by completely guessing every answer (like you are not even going to bother reading the questions)?

**Step 1: Calculate the individual probabilities**

- $P(\text{correct answer}) = p = \frac{1}{4} = 0.25$
- $P(\text{incorrect answer}) = q = \frac{3}{4} = 0.75$

**Step 2: Determine the number of events**

$n$  = total number of questions = 20

$x$  = number of correct scores = 10

$n-x$  = number of incorrect scores = 10

Step 3: Substitute the values for p, q, x, and n in the binomial expansion equation

$$\frac{n!}{x! (n-x)!} p^x q^{(n-x)}$$

$$P = (20!/10! \times 10!)(0.25)^{10}(0.75)^{10}$$

$$P = 184756. \times 5.37E^{-08}$$

$$P = 0.0099 = 0.99\%$$

0.99% chance to pass the test without studying!

$$\frac{2.43\text{E}^{+18}}{1.31\text{E}^{+13}} = 184756$$

$$P = (20!/10! \times 10!)(0.25)^{10} \times (0.75)^{10}$$

$$(0.25)^{10}(0.75)^{10} = 5.37\text{E}^{-08}$$

$$P = 184756 \times (0.25)^{10} \times (0.75)^{10}$$

$$184756 \times 5.37\text{E}^{-08} = 0.0099$$





$$P = 0.0099 = 0.99\%$$

$$\frac{n!}{x! (n-x)!} p^x q^{(n-x)}$$

0.99% of chance that you will pass the test without studying!

# Class test

Week 5, starts at 9AM Wed 7<sup>th</sup> of August

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**Are you worried about the test? Don't panic, study hard and watch this to have a laugh and relax:**

**[https://www.youtube.com/watch?v=hlvZ\\_8V6uc4](https://www.youtube.com/watch?v=hlvZ_8V6uc4)**

