AP Bio Unit Reviews

Unit 5: Heredity

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Recorded FRQ Fridays on YouTube

120+ Quizizz Games on Weebly

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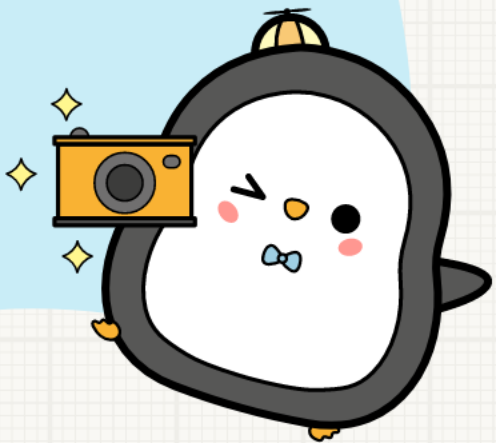
Weebly: www.apbiopenguins.weebly.com



Today's Plan

Meiosis

Genetics

- Mendelian
- Non-Mendelian
- Chromosomal

Practice Questions

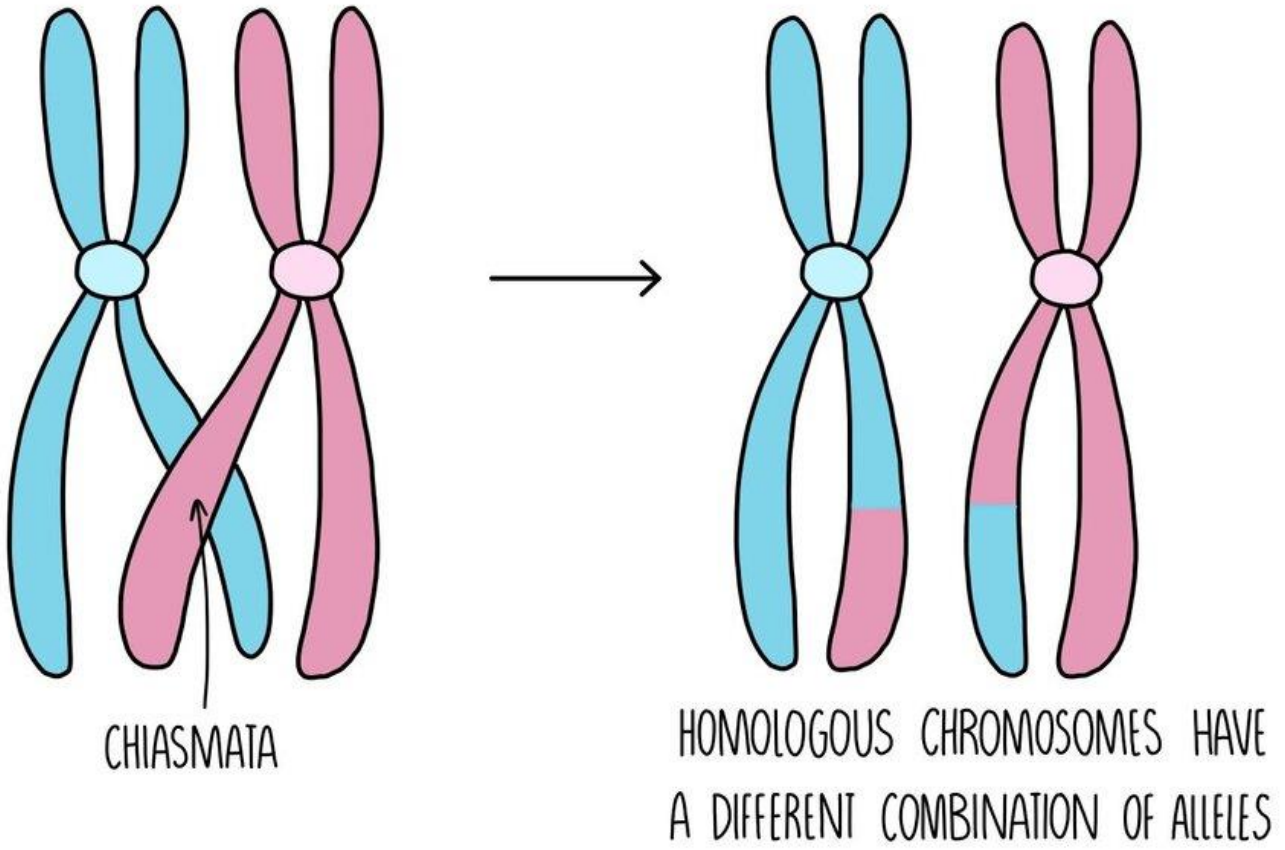
Unit 5 Q&A

Prophase I

Chromatin condenses

Sister chromatids/homologous chromosomes align

CROSSING OVER



Meiosis

Meiosis I:
Homologous Chromosomes

Prophase I
Chromatin condenses
Sister chromatids/homologous chromosomes align
CROSSING OVER

Metaphase I
HOMOLOGOUS CHROMOSOMES
align on the metaphase plate
INDEPENDENT ASSORTMENT

Anaphase I
HOMOLOGOUS CHROMOSOMES
separate to opposite poles

Telophase I
Nuclear envelope forms around the HAPLOID daughter cells

Meiosis II:
Sister Chromatids

Prophase II
Chromatin condenses
Sister chromatids align

Metaphase II
SISTER CHROMATIDS align on the metaphase plate

Anaphase II
SISTER CHROMATIDS separate to opposite poles

Telophase II
Nuclear envelope forms around the HAPLOID daughter cells

Mitosis vs. Meiosis

	Parent Cell Ploidy	Rounds of DNA Replication	Rounds of Nuclear Division	Daughter Cell Ploidy	Number of Daughter Cells
Mitosis	Diploid	1	1	Diploid	2
Meiosis	Diploid	1	2	Haploid	4

	Compare to Parent Cell	Crossing Over	Independent Assortment
Mitosis	Identical	Does not occur	Does not occur
Meiosis	Genetically Distinct	Occurs in Prophase I	Occurs in Metaphase I

Inheritance Patterns

Complete Dominance

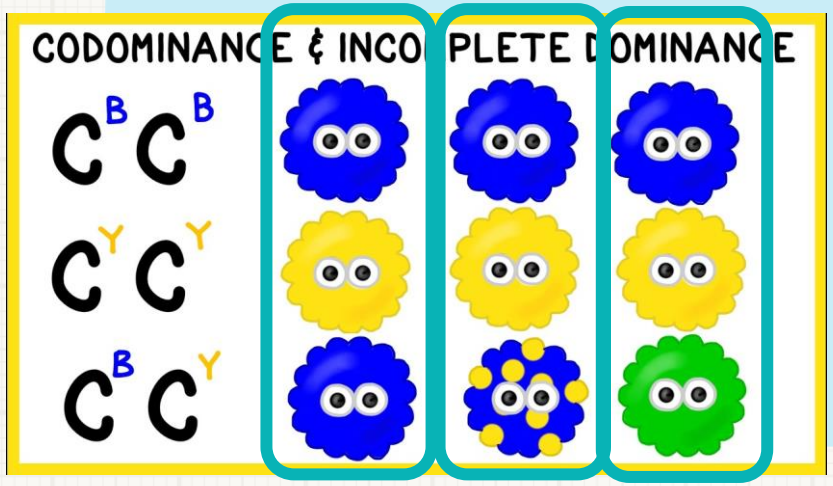
Homozygous dominant and heterozygous look the same

Codominance

Heterozygous is both dominant traits in organism

Incomplete Dominance

Heterozygous is a blend between he two dominant traits



	Y	y
Y	YY	Yy
y	Yy	yy

Yellow: ¾
Green: ¼

	R	r
R	RR	Rr
r	Rr	rr

Round: ¾
Wrinkled: ¼

Yellow & Round: ¾ x ¾ = 9/16
Yellow & Wrinkled: ¾ x ¼ = 3/16
Green & Round: ¼ x ¾ = 3/16
Green & Wrinkled: ¼ x ¼ = 1/16

Monohybrid

Heterozygous for ONE trait

Complete Dominance:
3:1 ratio

Incomplete or Codominance:
1:2:1

Dihybrid

Heterozygous for TWO traits

Complete Dominance:
9:3:3:1 ratio

Incomplete or Codominance:
6:3:3:2:1:1

Inheritance Patterns

Autosomal Inheritance

Allele is located on an autosome (non-sex chromosome)

Sex-Linked

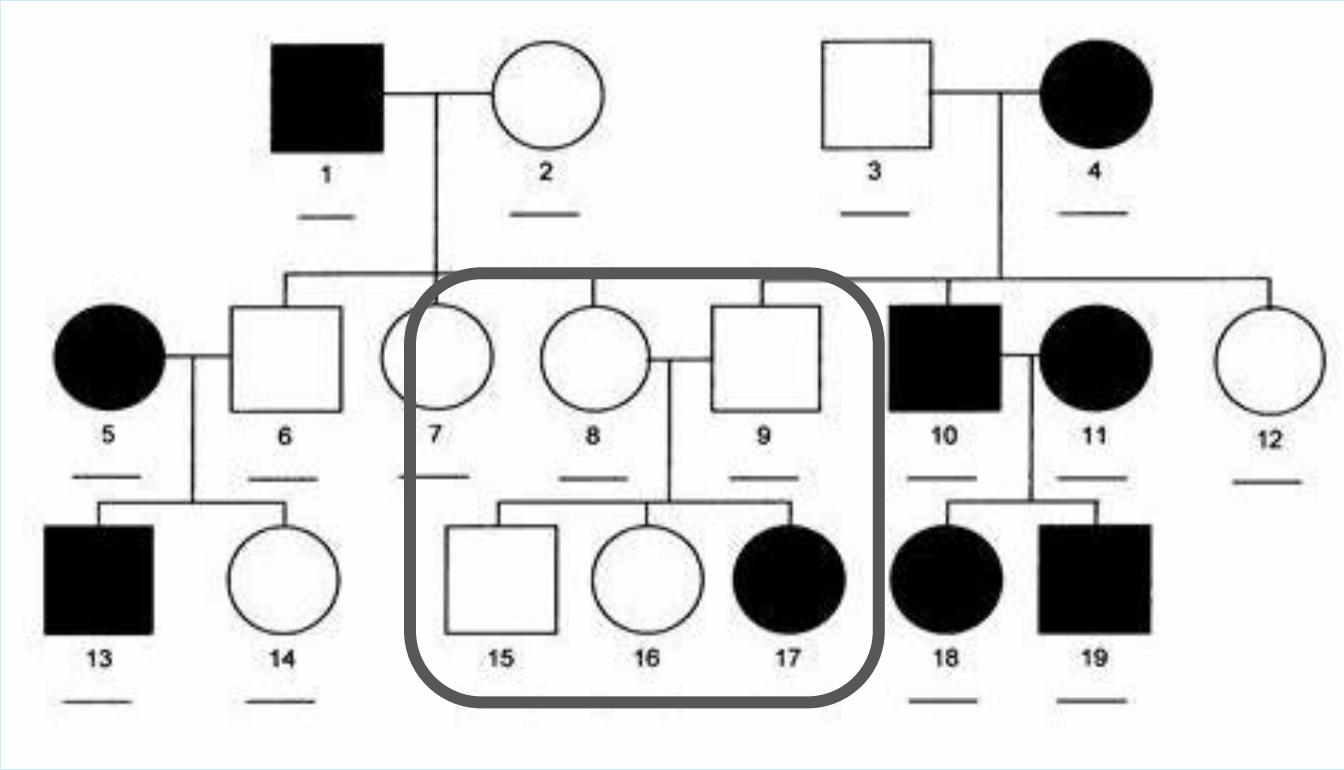
Allele is located on a sex chromosome

Maternal Inheritance

Allele is located on the DNA found in a mitochondrial or chloroplast

Linked Genes

Genes located on the same chromosome closely together



Autosomal Recessive

Inheritance Patterns

Autosomal Inheritance

Allele is located on an autosome (non-sex chromosome)

Sex-Linked

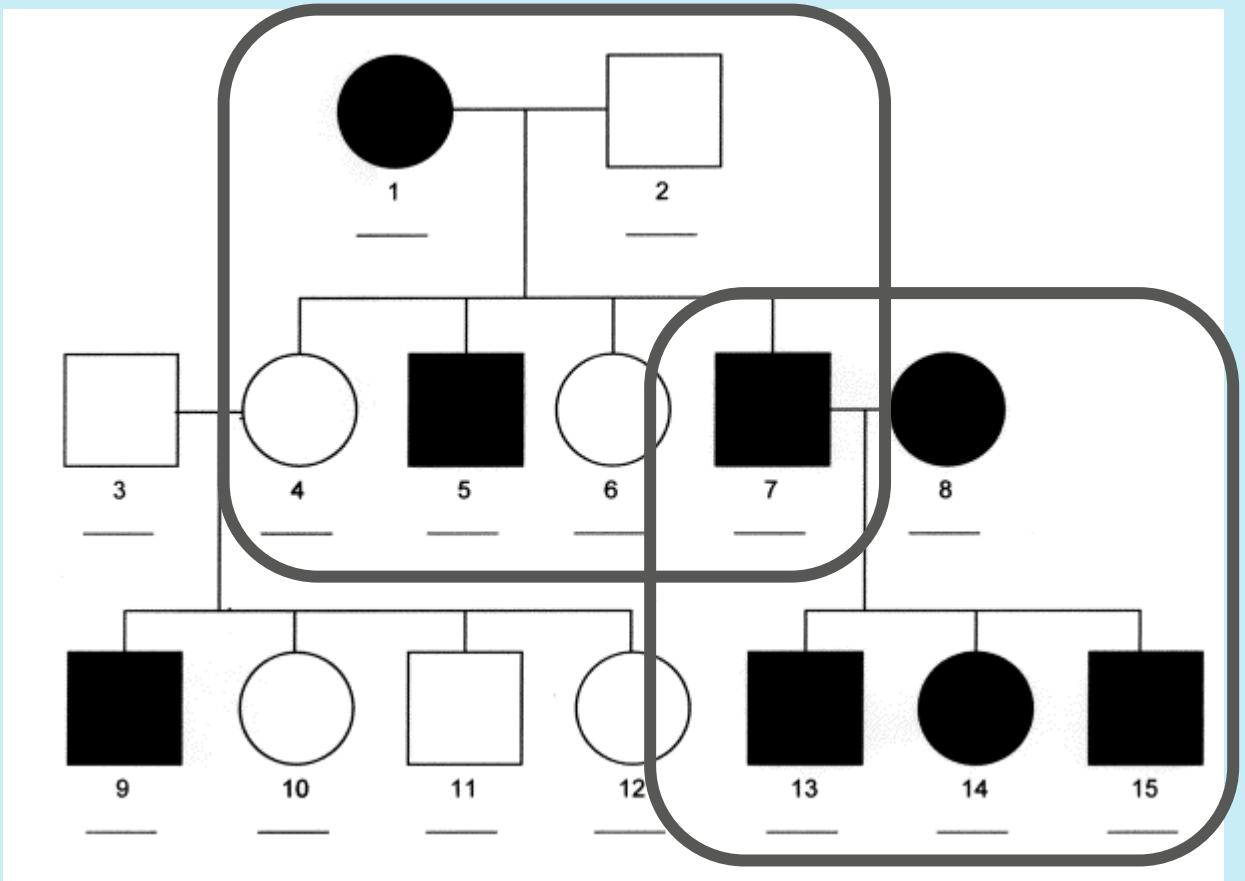
Allele is located on a sex chromosome

Maternal Inheritance

Allele is located on the DNA found in a mitochondrial or chloroplast

Linked Genes

Genes located on the same chromosome closely together



X-linked recessive

Inheritance Patterns

Autosomal Inheritance

Allele is located on an autosome (non-sex chromosome)

Sex-Linked

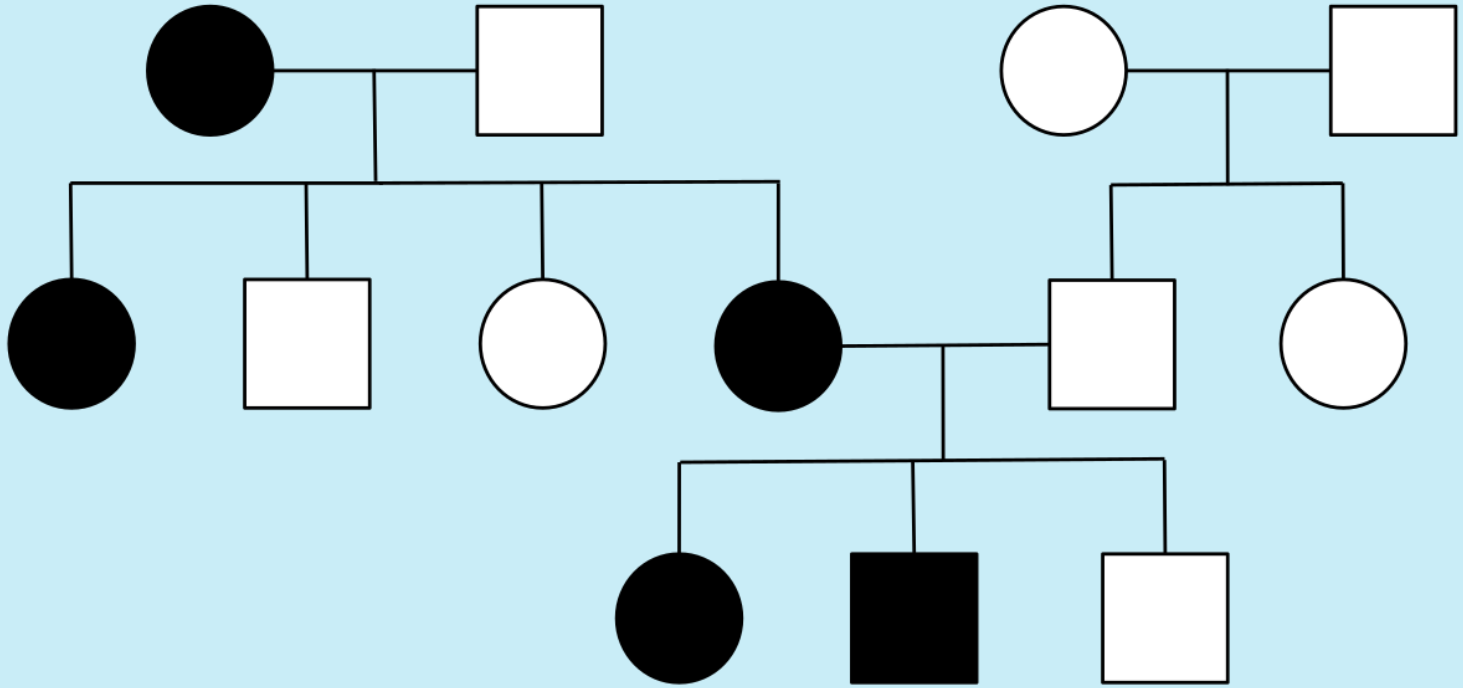
Allele is located on a sex chromosome

Maternal Inheritance

Allele is located on the DNA found in a mitochondrial or chloroplast

Linked Genes

Genes located on the same chromosome closely together



Autosomal Dominant

Inheritance Patterns

Autosomal Inheritance

Allele is located on an autosome (non-sex chromosome)

Sex-Linked

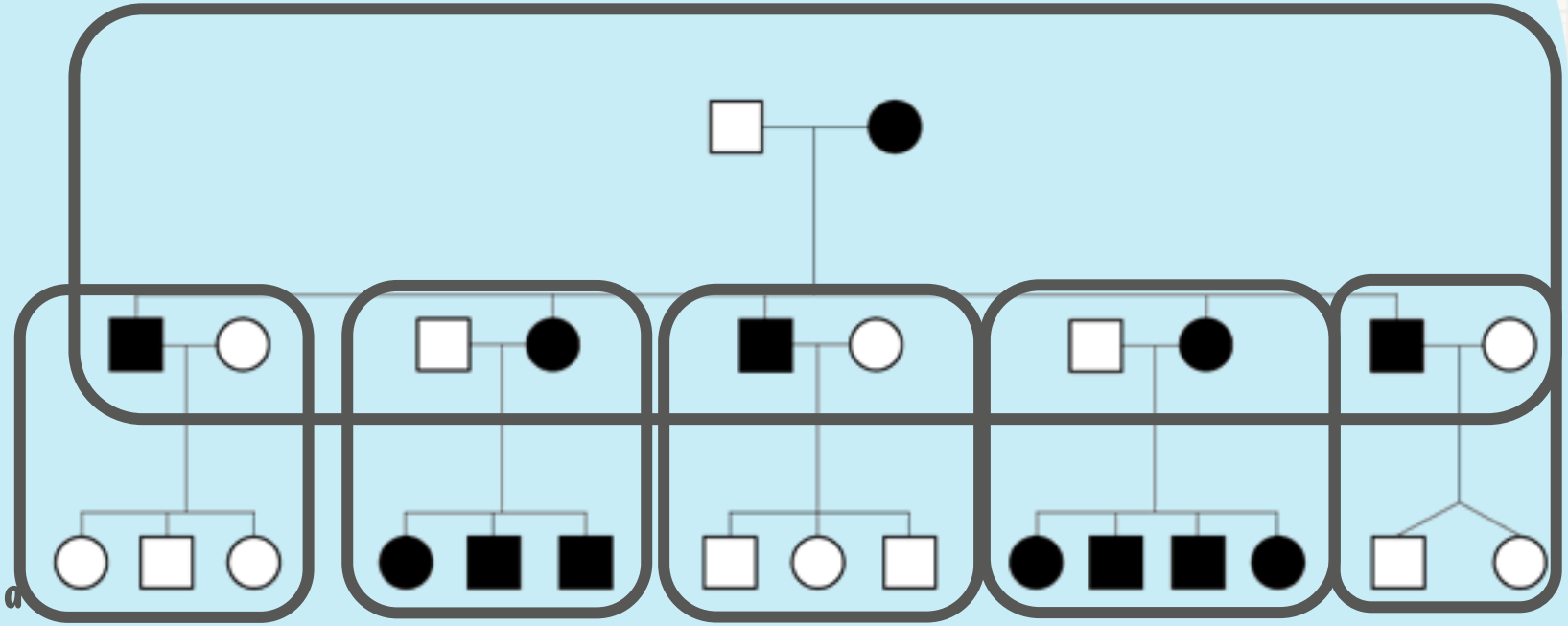
Allele is located on a sex chromosome

Maternal Inheritance

Allele is located on the DNA found in a mitochondrial or chloroplast

Linked Genes

Genes located on the same chromosome closely together

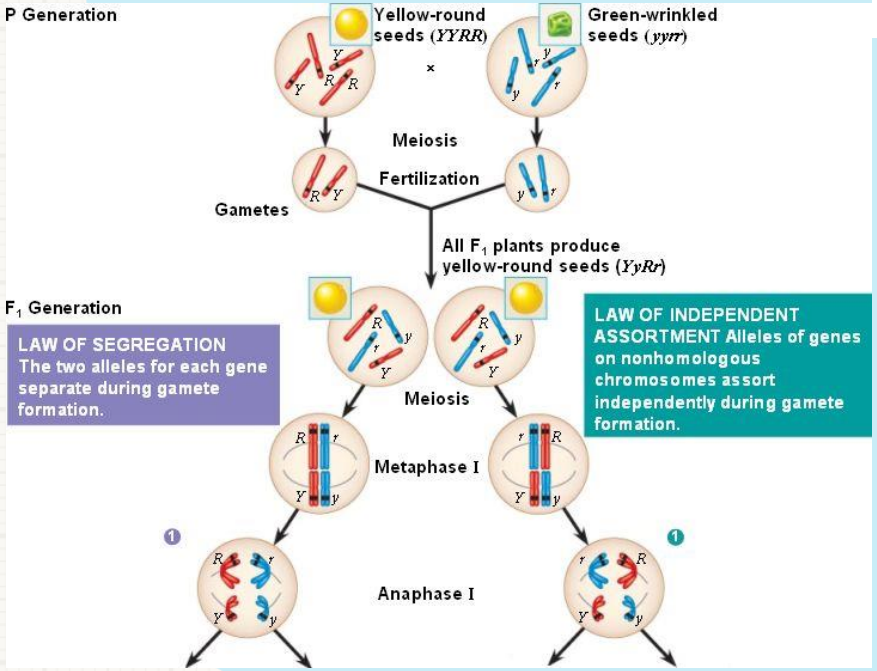


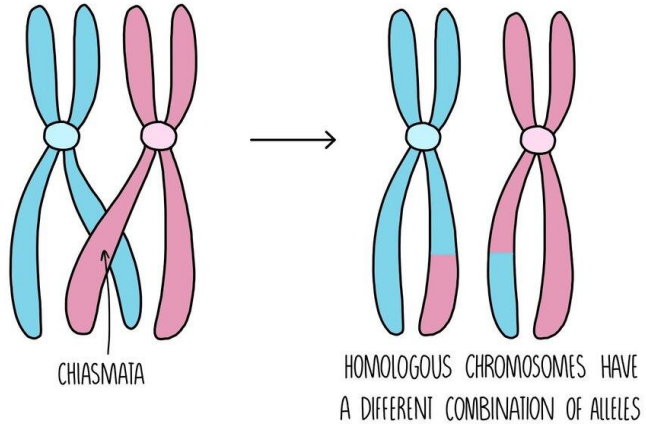
Mitochondrial Inheritance

Chromosomal Inheritance

Genetic Variation

- Crossing Over
- Independent Assortment
- Law of Segregation
- Random Fertilization





Chromosomal Basis of Inheritance

concept that genes are located on chromosomes and are passed from parent to offspring during reproduction.

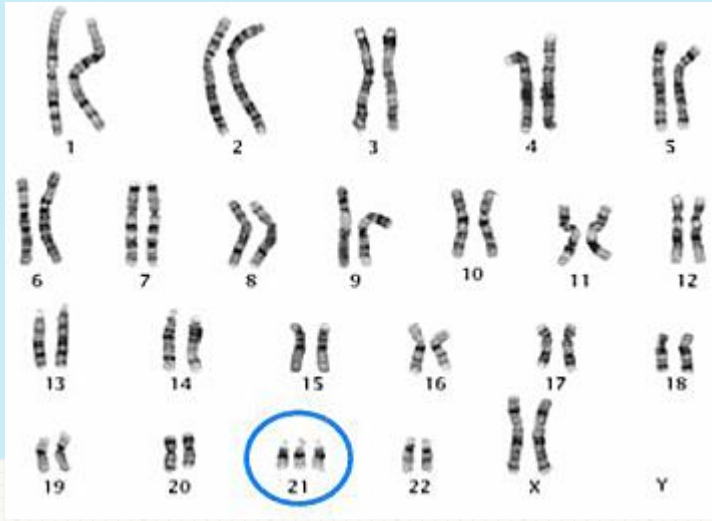
Human Genetic Disorders

Single Affected/Mutated Allele

- Sickle Cell Disease
- Tay Sachs Disease
- Huntington's Disease

Chromosomal Changes

- Downs Syndrome/Trisomy 21
- Klinefelter Syndrome/XXY
- Turner Syndrome/XO



Phenotype Plasticity

- Result of environmental factors influencing gene expression
- individuals with the same genotype exhibit different phenotypes in different environments

Normal conditions: only rabbit's feet, tail, ears and nose are black
If ice pack placed on back (with absent fur), the new fur will grow back black

Environmental Effects on Phenotype

Diets lacking carotenoids result in very little color in normally pigmented species. Population differences have been related to the presence of specific food plants.

Hydrangea flowers have a range of phenotypes based on the acidity and aluminum content of the soil.

Multiple Choice Practice:

Humans have a diploid number ("2n") of 46. Which of the following statements best predicts the consequence if meiosis did not occur during gametogenesis?

a. The gametes would get larger from one generation to the next.

b. The chromosome number would double with each generation.

c. The chromosome number would be halved with each generation.

d. The chromosome number would triple with each generation.

Phenotype	Number of Offspring
Gray body, long wings	42
Black body, apterous wings	41
Gray body, apterous wings	9
Black body, long wings	8

A student in a biology class crossed a male Drosophila melanogaster having a gray body and long wings with a female D. melanogaster having a black body and apterous wings. The following distribution of traits was observed in the offspring.

Which of the following is supported by the data?

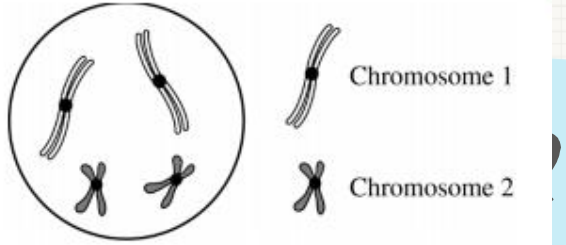
a. The alleles for gray body and long wings are dominant.

b. The alleles for gray body and long wings are recessive.

c. Genes for the two traits are located on two different chromosomes, and independent assortment occurred.

d. Genes for the two traits are located close together on the same chromosome and crossing over occurred between the two gene loci.

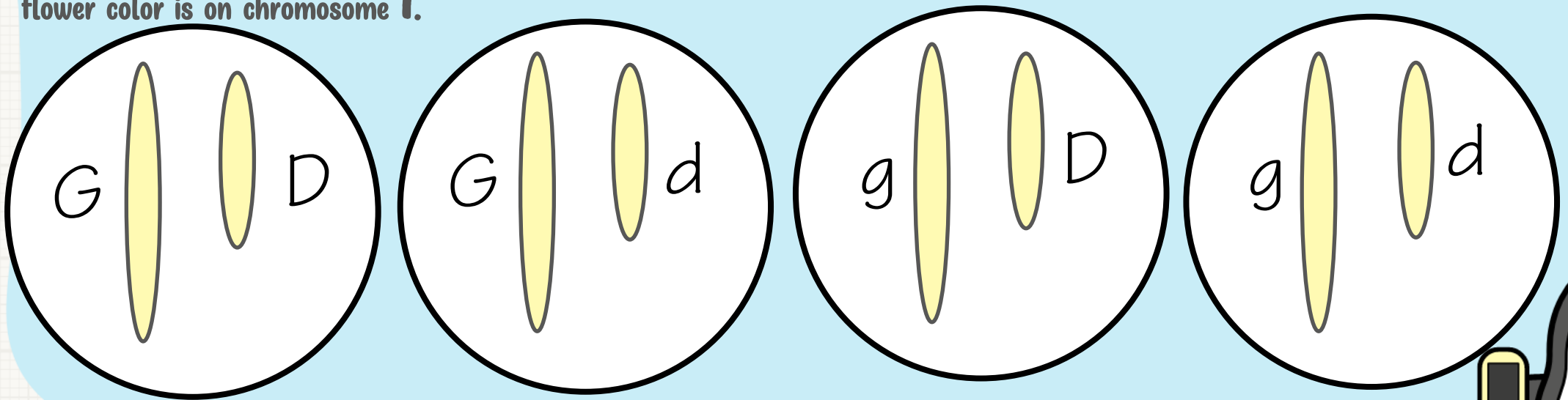
Free Resp 2016 #7):



In a certain species of plant, the diploid number of chromosomes is 4 ($2n = 4$). Flower color is controlled by a single gene in which the green allele (G) is dominant to the purple allele (g). Plant height is controlled by a different gene in which the dwarf allele (D) is dominant to the tall allele (d). Individuals of the parental (P) generation with the genotypes GGDD and ggdd were crossed to produce F_1 progeny.

F_1 = GgDd

(a) Construct a diagram below to depict the four possible normal products of meiosis that would be produced by the F_1 progeny. Show the chromosomes and the allele(s) they carry. Assume the genes are located on different chromosomes and the gene for flower color is on chromosome 1.



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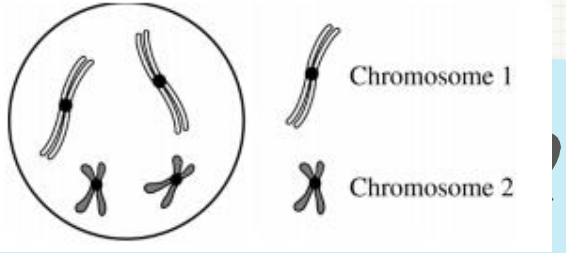

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F_1 = GgDd

(b) Predict the possible phenotypes and their ratios in the offspring of a testcross between an F_1 individual and a ggdd individual.

Gg	gg
Gg	gg

½ Green
½ Purple

Dd	dd
Dd	dd

½ Dwarf
½ Tall

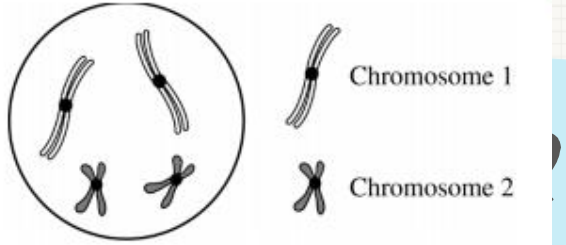
Purple Dwarf = ½ x ½ = ¼
Purple Tall = ½ x ½ = ¼

Green Dwarf = ½ x ½ = ¼
Green Tall = ½ x ½ = ¼

Prediction (1 point)

- 1 green dwarf: 1 green tall: 1 purple dwarf: 1 purple tall

Free Resp 2016 #7):



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F_1 = GgDd

(b) Predict the possible phenotypes and their ratios in the offspring of a testcross between an F DEMO individual and a ggdd individual.

Prediction (1 point)

- 1 green dwarf: 1 green tall: 1 purple dwarf: 1 purple tall

(c) If the two genes were genetically linked, describe how the proportions of phenotypes of the resulting offspring would most likely differ from those of the testcross between an F_1 individual and a ggdd individual.

Identify difference (1 point)

- The majority/greater than 50 percent would have the parental plant phenotypes
- Greater than 25 percent would be green dwarf plants and greater than 25 percent would be purple tall plants
- Less than 25 percent would be green tall plants and less than 25 percent would be purple dwarf plants

Free Response Practice (2020 CED):

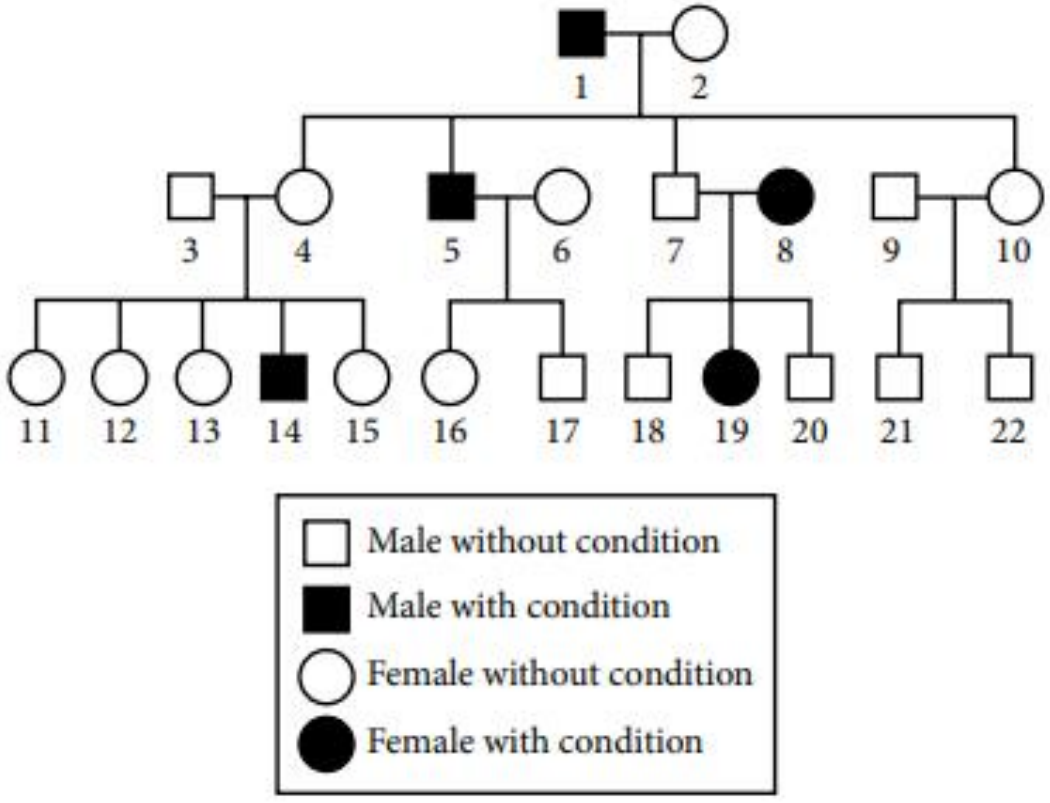


Figure 1. Inheritance of a particular condition over three generations of a family

In humans, the gene that determines a particular condition has only two alleles, one of which (B) is completely dominant to the other (b). The phenotypes of three generations of a family with respect to the condition are shown in the pedigree in Figure 1. Individuals are numbered.

Free Response Practice (2020 CED):

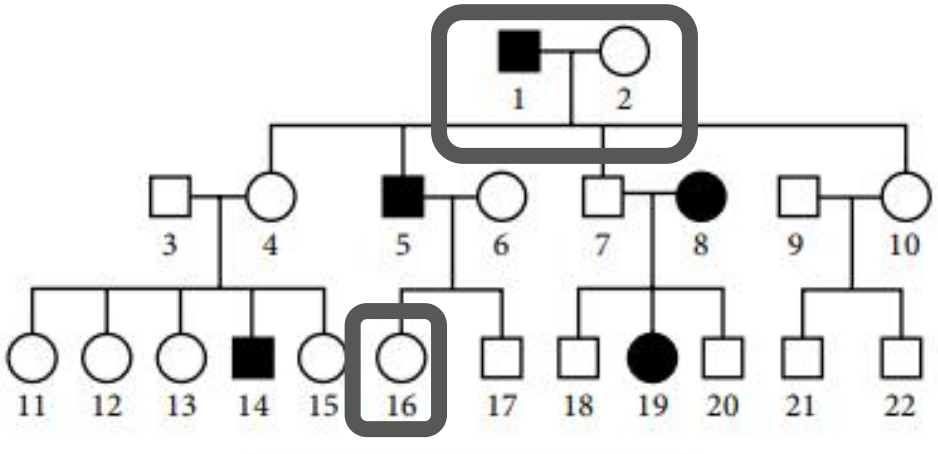
(a) Describe the process in eukaryotes that ensures that the number of chromosomes will not double from parent to offspring when gametes fuse during fertilization.

Describe the process in eukaryotes that ensures that the number of chromosomes will not double from parent to offspring when gametes fuse during fertilization.

- Homologous pairs of chromosomes separate in meiosis I, so the gametes are haploid (n), and each gamete receives only one member of each chromosome pair.

Free Response Practice (2020 CED):

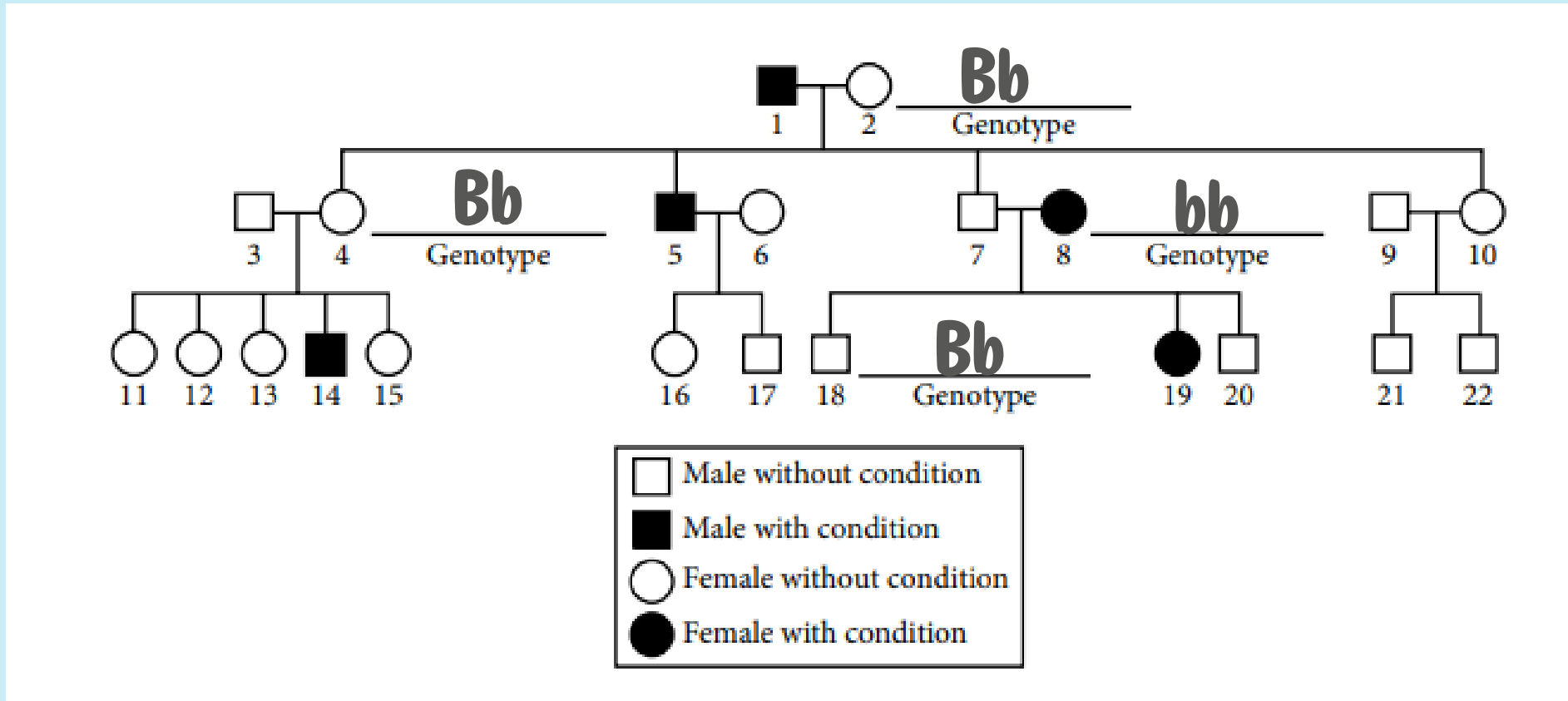
(b) Explain how any one chromosome in individual 16 contains DNA that came from both individuals 1 and 2.



Individual 5 inherited one member of each homologous pair of chromosomes from individuals 1 and 2. During gamete formation in individual 5, crossing over occurred between nonsister chromatids in each homologous pair. Thus each chromosome formed and passed on to individual 16 contains DNA from both 1 and 2.

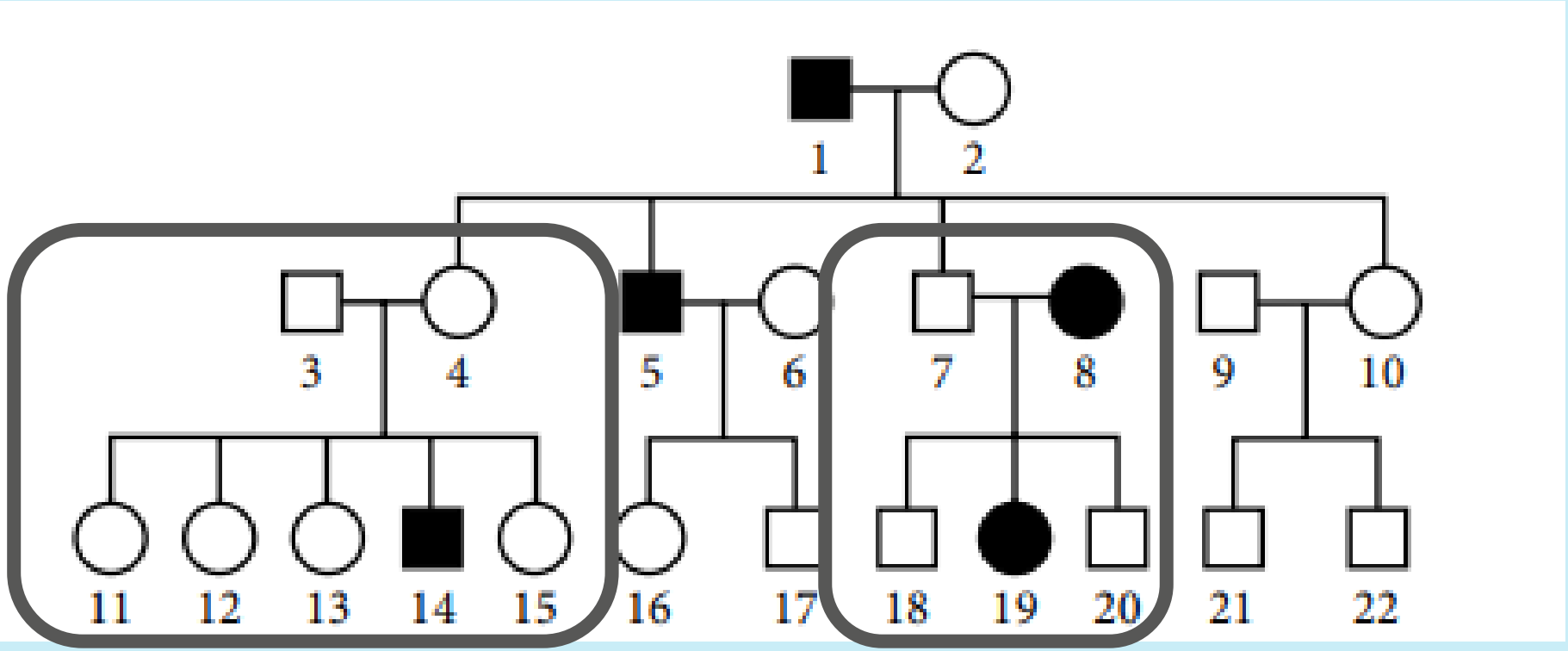
Free Response Practice (2020 CED):

(c) Use the template figure of the pedigree and the allele designations B and b to indicate the genotypes of individuals 2, 4, 8, and 18.



Free Response Practice (2020 CED):

(d) Based on the pedigree, explain whether the inheritance pattern of the condition is sex-linked or autosomal and dominant or recessive.



The disease phenotype is recessive and is autosomal/not sex-linked. It cannot be dominant because individuals 3 and 4 do not have it, but their offspring 14 does. It is not sex-linked because if it was Y-linked, all male offspring of males with the disease phenotype would have the trait, and they do not.

Free Response Practice (2003 #1b):

In fruit flies, the phenotype for eye color is determine by a certain locus, E indicates the dominant allele and e indicates the recessive allele. The cross between a male wild-type fruit fly and a female white-eyed fruit fly produced the following offspring

	Wild-type Male	Wild-type Female	White-eyed Male	White-eyed Female	Brown-eyed Female
F1	0	45	55	0	1

The wild-type and white-eyed individuals from the F1 generation were then crossed to produce the following offspring.

F2	23	31	22	24	0

(b) Use a chi-square test on the F2 generation data to analyze your prediction of the parental genotypes. Show all your work and explain the important of your final answer.

Free Response Practice (2003 #1b):

	Wild-type Male	Wild-type Female	White-eyed Male	White-eyed Female	Brown-eyed Female
F1	0	45	55	0	1

The wild-type and white-eyed individuals from the F1 generation were then crossed to produce the following offspring.

F2	23	31	22	24	0

1. Null hypothesis: The parent genotypes are X^EX^e and X^eY.
2. Calculate Chi Square value

	X^e	Y
X^E	X^EX^e	X^EY
X^e	X^eX^e	X^eY

¼ Wild-type Female
¼ White-eyed Female
¼ Wild-type Male
¼ White-eued Male

Phenotype	Observed (o)	Expected (e)
Wild-type Male	23	25
Wild-type Female	31	25
White-eyed Male	22	25
White-eyed Female	24	25

Free Response Practice (2003 #1b):

	Wild-type Male	Wild-type Female	White-eyed Male	White-eyed Female	Brown-eyed Female
F1	0	45	55	0	1

The wild-type and white-eyed individuals from the F1 generation were then crossed to produce the following offspring.

F2	23	31	22	24	0

2. Calculate Chi Square value

Phenotype	Observed (o)	Expected (e)	(o-e)	$(o-e)^2$	$((o-e)^2)/e$
Wild-type Male	23	25	-2	4	4/25
Wild-type Female	31	25	6	36	36/25
White-eyed Male	22	25	-3	9	9/25
White-eyed Female	24	25	-1	1	1/25
					50/25 = 2.0

Free Response Practice (2003 #1b):

Phenotype	Observed (o)	Expected (e)	(o-e)	$(o-e)^2$	$((o-e)^2)/e$
Wild-type Male	23	25	-2	4	4/25
Wild-type Female	31	25	6	36	36/25
White-eyed Male	22	25	-3	9	9/25
White-eyed Female	24	25	-1	1	1/25
					50/25 = 2.0

3. Find degrees of freedom

   4 total class – 1 = 3

4. Find critical value

   df = 3 AND p = 0.05, so critical value is 7.81

Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.81	9.49	11.07	12.59	14.07	15.51
0.01	6.63	9.21	11.34	13.28	15.09	16.81	18.48	20.09

5. Conclusion (reject or fail to reject)

   Since the calculated value (2.0) is < the critical value from the table (7.81), you **fail to reject** the null hypothesis (the parent's genotypes are X^EX^e and X^eY)

Q & A

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