



هيكل 12 ADV حكومي

EOT 1 (BIO- C101)

2025/2026

المادة: الأحياء

المدرس: موسى زامل

تنذير

إعلان هام من الأكاديمية

تنوه أكاديميتنا إلى ضرورة الحفاظ على حقوق الملكية الفكرية الخاصة بالمحتوى التعليمي الذي نقدمه في بطاقاتنا التعليمية من فيديوهات، أوراق عمل واختبارات وغيره .

في هذه الفترة الخاصة بمراجعات "الهيكل" لمادة الفصل الدراسي الأول، نود التأكيد على التالي:

يمنع منعاً باتاً نشر أوراق الشرح المطولة أو تصوير فيديوهات الشرح الخاصة بنا أو إعادة توزيعها بأي شكل من الأشكال إذ يُعتبر نشر أي من هذه المواد دون إذن مسبق مخالفة قانونية، ويعرض الفاعل للمساءلة والملاحقة القانونية، لكن **يسمح فقط** بنشر ملزمة الهيكل (غير المطولة)

نشكركم على تفهمكم وتعاونكم في حماية حقوق الجميع ودعم الأكاديمية في توفير محتوى تعليمي آمن وموثوق.

بطاقة الأحياء صف 12 متقدم شرح أ. مومس زامل



● ● ● جاهز للنجاح وإطلاق إبداعاتك ● ● ●

فيديوهات ▶ ملازم شرح ▶ أوراق عمل ▶ اختبارات

مراجعة تفصيلية شاملة للهيكل

للاشتراك في البطاقة واتساب الدعم
الفني للأكاديمية 0569174493

1	BIO.3.3.02.011: Explain concepts of genotype, phenotype, dominance, incomplete dominance, codominance, recessiveness, sex linkage	FIGURE 2	4
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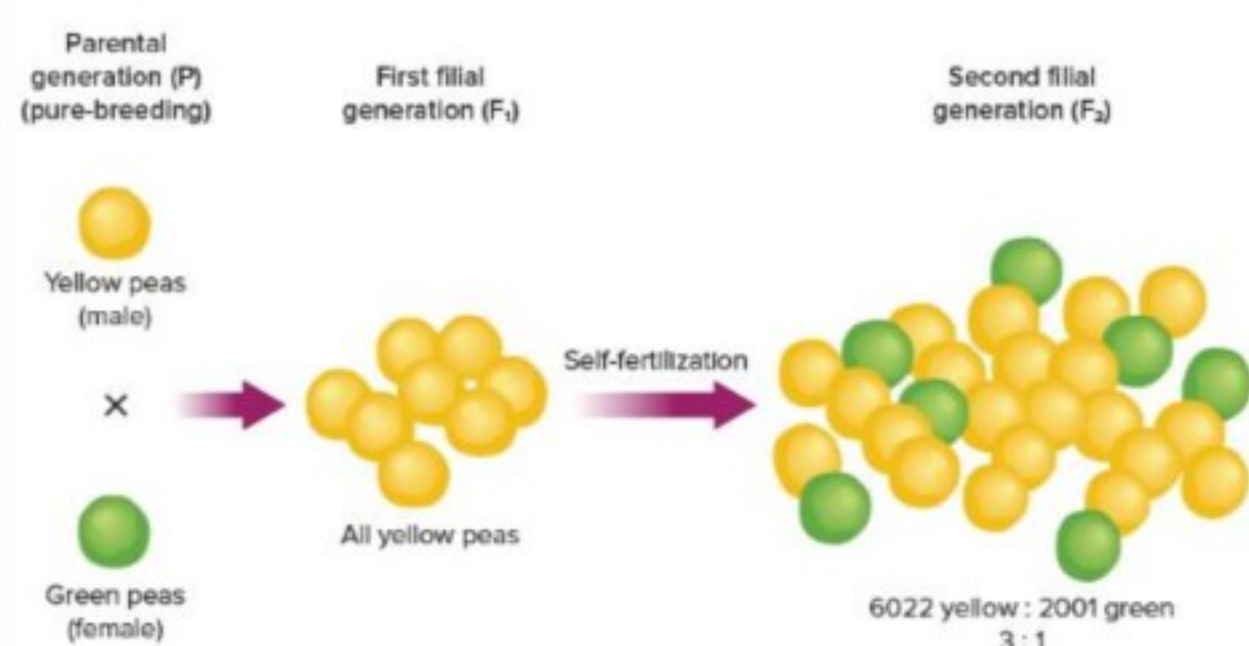


Figure 2 The results of Mendel's cross involving true-breeding pea plants with yellow seeds and green

seeds are shown here.

Explain why the seeds in the F₁ generation were all yellow.

Caption Question Fig. 2: All the seeds in the F₁ generation received one copy of the gene for yellow color, which masks the gene for green color.

Based on Mendel's experiment, what trait appeared in all of the F₁ generation plants?

- a. Green seeds
- b. Both green and yellow seeds
- c. Yellow seeds
- d. Neither green nor yellow seeds

What ratio of yellow to green seeds did Mendel observe in the F₂ generation?

- a. 1:1
- b. 2:1
- c. 3:1
- d. 4:1

In Mendel's experiment, what process did he use to produce the F₂ generation?

- a. Cross-pollination between different plants
- b. Self-fertilization of F₁ plants
- c. Cross-pollination between F₁ and P generation plants
- d. Artificial selection of specific traits

What conclusion can be drawn about the green-seed trait in the F₁ generation?

- a. The trait was permanently lost
- b. The trait mutated into a new form
- c. The trait was masked or hidden
- d. The trait was equally expressed with yellow

How many different traits did Mendel study that showed the 3:1 ratio in the F₂ generation?

- a. Three
- b. Five
- c. Seven
- d. Nine

MOE-Q: Why were all the seeds in the F₁ generation yellow when a pure-breeding yellow-seeded plant was crossed with a pure-breeding green-seeded plant?

- a. Yellow seed color is a recessive trait that masks green.
- b. Green seed color is dominant and always appears in hybrids.
- c. Yellow seed color is dominant over green, so all offspring showed the dominant trait.
- d. The F₁ generation inherited only green alleles from both parents.



2	BIO.3.3.02.011: Explain concepts of genotype, phenotype, dominance, incomplete dominance, codominance, recessiveness, sex linkage	Get it	5
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Dominance

When Mendel allowed the F_1 generation to self-fertilize, he showed that the recessive allele for green seeds had not disappeared. Mendel concluded that the green seed form of the trait did not show up in the F_1 generation because the yellow-seed form of the trait is dominant. When it is present, it masks the allele for the green-seed form.

When modeling inheritance, the dominant allele is represented by a capital letter, and the recessive allele is represented by a lowercase letter. An organism with two of the same alleles for a particular trait is **homozygous** (ho muh ZI gus) for that trait. Homozygous, yellow-seed plants are YY and green-seed plants are yy. An organism with two different alleles for a particular trait is **heterozygous** (heh tuh roh ZY gus) for that trait. A bean plant that is heterozygous for the trait of seed color is Yy. When alleles are present in the heterozygous state, the dominant trait will be observed. The recessive trait will be masked.

Genotype and phenotype

A yellow-seed plant could be homozygous or heterozygous. An organism's appearance does not always indicate which alleles are present. The observable characteristic or outward expression of an allele pair is called the **phenotype**. The phenotype of pea plants with the genotype yy will be green seeds. The organism's allele pairs are called its **genotype**. The genotype of yellow-seed plants could be YY or Yy. In plants with green seeds, the genotype is yy.



Get It?

Infer whether an individual with a recessive phenotype for a trait is heterozygous or homozygous for that trait.



Get It?

An individual with a recessive phenotype is homozygous for that trait.

MOE-Q: A heterozygous organism is best described as which of these?

- a. Dominant
- b. Genotype
- c. True-breeding
- d. Hybrid

If an individual displays a recessive phenotype for a trait, what can be inferred about their genotype?

- a. The individual is heterozygous for the trait.
- b. The individual is homozygous dominant for the trait.
- c. The individual is homozygous recessive for the trait.
- d. The individual has no alleles for the trait.

If a person has a recessive phenotype, what can be concluded about their alleles?

- a. They carry one dominant and one recessive allele
- b. They carry two dominant alleles
- c. They carry two recessive alleles
- d. They carry no alleles for the trait

Why can't a heterozygous individual express a recessive phenotype?

- a. Because dominant alleles are stronger and always expressed
- b. Because recessive alleles are not inherited
- c. Because heterozygous individuals lack any recessive alleles
- d. Because dominant alleles are only expressed in homozygous form

Which sentence is correct?

- a. Different alleles of the same gene are located at the same locus on different homologous chromosomes.
- b. Different alleles of the same gene are located at different loci on different homologous chromosomes.
- c. Different genes of the same alleles are located at the same locus on different homologous chromosomes.
- d. Different alleles of the same gene are located at different loci on the same chromosome.

Get It?

Restate Mendel's law of segregation in your own words.

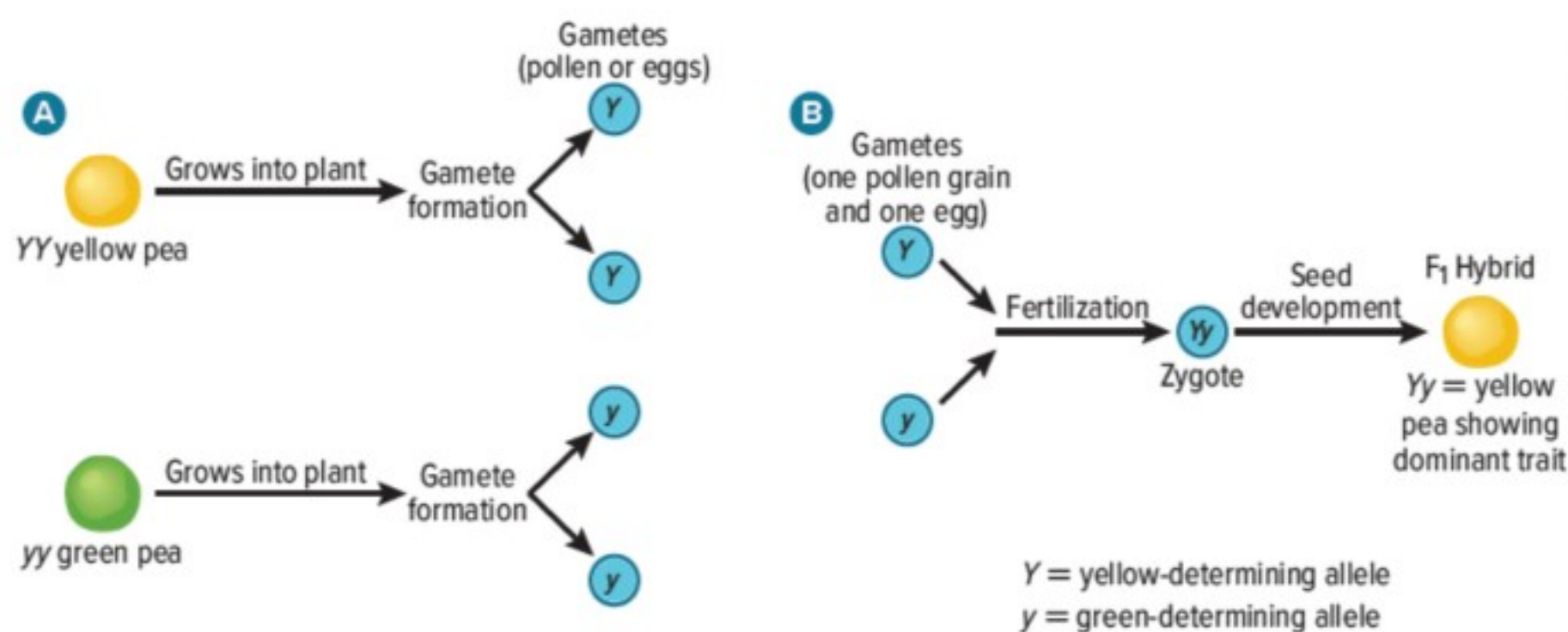


Figure 3 During gamete formation in the YY or yy plant, the two alleles separate, resulting in Y or y in the gametes. Gametes from each parent unite during fertilization.

Explain how the zygote that results from fertilization has a different genotype than either parent plant.

- They remain together in the gamete
- They separate, with each gamete receiving one allele from the pair
- They duplicate, with each gamete receiving both alleles
- They mutate into different alleles during meiosis

In Figure 3, the F₁ hybrid pea plants all have yellow seeds. Why do they express the yellow seed trait despite having a green-seed allele?

- The green-seed allele is damaged during fertilization
- The yellow-seed allele is dominant over the green-seed allele
- The yellow-seed allele mutates the green-seed allele during development
- The F₁ generation always expresses traits from the female parent plant

How does the genotype of the F₁ hybrid zygote differ from either parent plant in Mendel's experiment?

- It has more chromosomes than either parent
- It has fewer alleles than either parent
- It is heterozygous (Yy), while both parents were homozygous (YY or yy)
- It contains entirely new alleles not present in either parent

Based on the law of segregation, if two F₁ hybrid pea plants (Yy) are crossed, what proportion of their offspring would be expected to have green seeds?

- 0%
- 25%
- 50%
- 75%

Which statement best explains why the zygote resulting from fertilization has a different genotype than either parent plant?

- The zygote undergoes mutation during development
- The zygote receives one allele from each parent, combining their genetic material
- The zygote only expresses the dominant alleles from both parents
- The zygote randomly selects which parent's traits to express



Figure 6 Freckles are a dominant trait.
Identify the genotypes that can produce this phenotype.

Caption Question Fig. 6: **FF or Ff**

If both parents are heterozygous (Ff) for freckles, what is the probability of having a child with freckles?

- a. 25%
- b. 50%
- c. 75%
- d. 100%

In a cross between two heterozygous parents (Ff × Ff), what genotypic ratio would be expected in the offspring?

- a. 3:1 (dominant: recessive)
- b. 1:2:1 (homozygous dominant: heterozygous: homozygous recessive)
- c. 1:1 (dominant: recessive)
- d. 2:2 (dominant: recessive)

If a person has freckles, which of the following could be their genotype?

- a. ff only
- b. Ff only
- c. FF only
- d. Either FF or Ff

If two parents with freckles have a child without freckles, what must be true about the parents' genotypes?

- a. Both parents must be homozygous dominant (FF)
- b. Both parents must be homozygous recessive (ff)
- c. Both parents must be heterozygous (Ff)
- d. One parent must be homozygous dominant (FF) and the other heterozygous (Ff)

If a person without freckles (ff) has children with someone who is heterozygous for freckles (Ff), what percentage of their children would be expected to have freckles?

- a. 0%
- b. 25%
- c. 50%
- d. 75%

The appearance of freckles is a dominant trait that can be represented by (F). Suppose both of your parents have freckles and are heterozygous (Ff) for the trait. What is the possible phenotypic freckles to non-freckles ratio ?

- a. 1:2:1
- b. 3:1
- c. 1:1
- d. 1:4

What is the genotypes that can produce this phenotype.

- a. FF
- b. Ff
- c. Ff
- d. FF, Ff

11. What is genotypic freckles to non-freckles ratio?

- a. 1:1
- b. 1:3
- c. 3:1
- d. 1:2:1

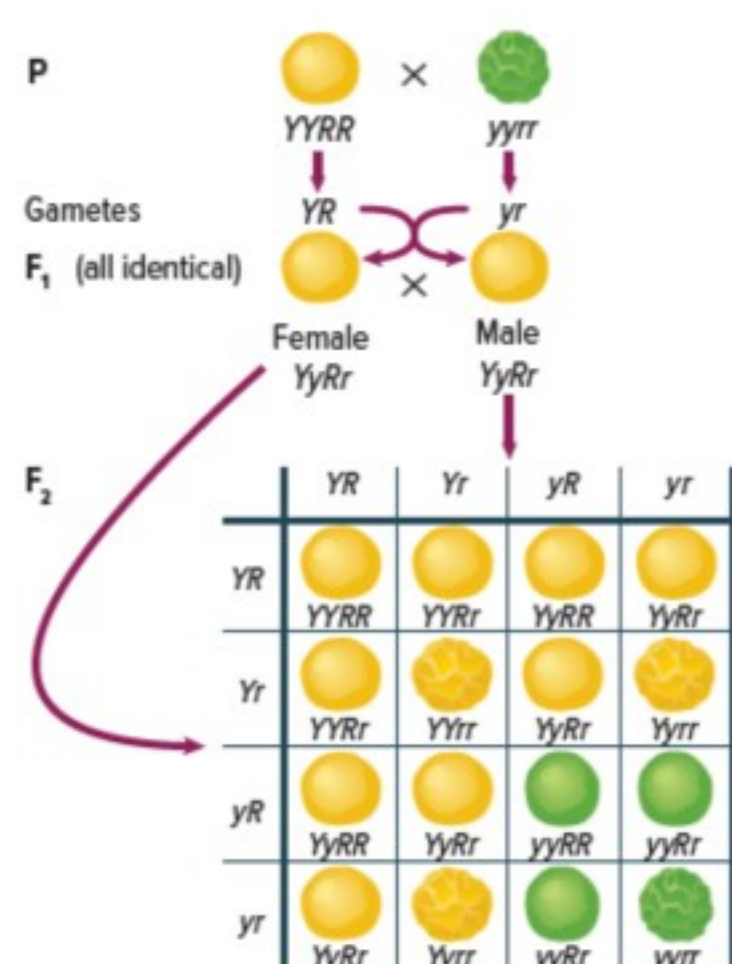


5

BIO.3.3.02.012: Use the Punnett square method to solve basic genetics problems involving monohybrid crosses, incomplete dominance, codominance, dihybrid crosses, and sex-linked genes.

FIGURE 8

9



Dihybrid cross

Figure 8 The dihybrid Punnett square visually presents the possible combinations of the possible alleles from each parent. Once Mendel established the inheritance patterns of a single trait, he began to examine simultaneous inheritance of two or more traits in the same plant. In garden peas, round seeds (*R*) are dominant to wrinkled seeds (*r*), and yellow seeds (*Y*) are dominant to green seeds (*y*). If Mendel crossed homozygous yellow, round-seed pea plants with homozygous green, wrinkle-seed pea plants, the P cross could be represented by $YYRR \times yyrr$. The F₁ generation genotype would be $YyRr$ —yellow, round-seed plants. These F₁-generation plants are called dihybrids because they are heterozygous for both traits. Examine the Punnett square in Figure 8. The number of squares for a dihybrid cross in a Punnett square is determined by the number of different types of alleles—*YR*, *Yr*, *yR*, or *yr*—produced by each parent from the first filial generation (F₁). In this case, the square is 4 squares × 4 squares because each parent produces four different types of gametes. The male gametes are written across the horizontal side and the female gametes are written on the vertical side. The possible combinations of each male and female gamete are written on the inside of each corresponding square.

What fraction of this cross will be recessive for both traits?

- a. 1/2 b. 1/4
c. 1/8 d. 1/16

If a purple tall plant ($PpTt$) is crossed with a white short plant ($pptt$), what is the resulting phenotypic ratio?

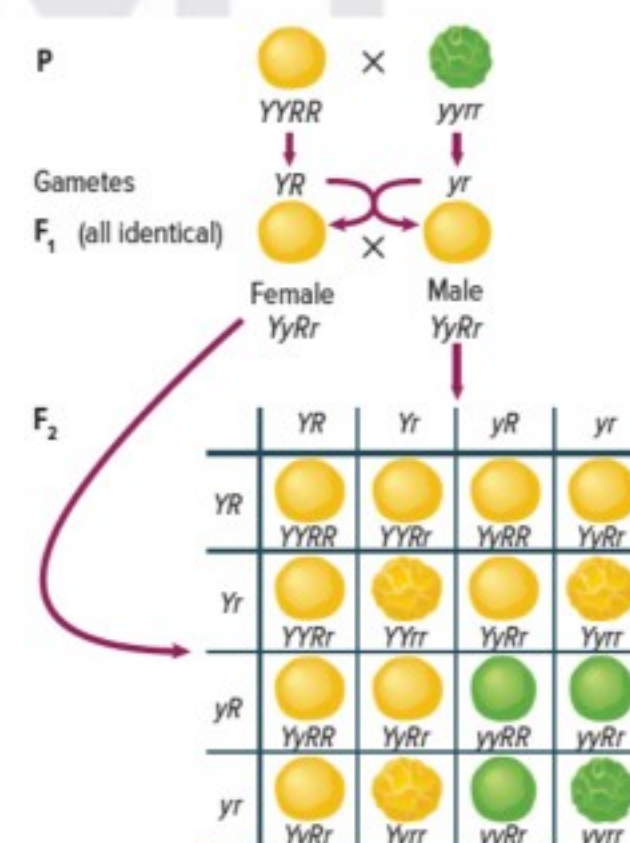
- a. all purple tall
b. 9:3:3:1 (9 purple tall to 3 purple short to 3 white tall to 1 white short)
c. 1:1:1:1 (1 purple tall to 1 purple short to 1 white tall to 1 white short)
d. 3:2 (3 purple tall to 2 purple short)

MOE -Q: The dihybrid Punnett square below visually presents the combination of possible alleles of two pea plants. Which is the phenotypic ratio of pea plants with yellow round peas in the second generation?

- a. 1:16
b. 3:16
c. 6:16
d. 9:16

Which gamete cannot come from an individual that has a genotype of $YyRr$?

- a. YY b. yr c. YR d. Yr



the



MOE -Q: In which situation are the phenotypes of F₂ offspring expected to follow the ratio of 9:3:3:1?

- A Monohybrid cross for linked genes
- A Dihybrid cross for linked genes
- A Monohybrid cross to law of segregation
- A Dihybrid cross to law of independent assortment

MOE -Q: The figure below shows a dihybrid mating Punnett square that presents possible combinations of the possible alleles from each parent. Which of the genotypes does the letter (A) refer to?

	YR	Yr	yR	yr
YR	YYRR	YYRr	YyRR	YyRr
Yr	YYRr	A	YyRr	Yyrr
yR	YyRR	YyRr	yyRR	yyRr
yr	YyRr	Yyrr	yyRr	yyrr

visually the following

- YyRr
- YYrr
- yyRr
- yyrr

In a dihybrid cross between YYRR × yyrr pea plants, what is the genotype of the F₁ generation?

- YYRR
- YyRr
- yyrr
- YYRr

How many different types of gametes can be produced by a dihybrid (YyRr) individual?

- 2
- 3
- 4
- 6

In a dihybrid cross Punnett square (F₁ × F₁), what phenotypic ratio would be expected in the F₂ generation?

- 9:3:3:1
- 3:1
- 1:2:1
- 1:1:1:1

If a dihybrid YyRr pea plant self-pollinates, what fraction of the offspring would be expected to have the recessive phenotype for both traits (green, wrinkled seeds)?

- 1/2
- 1/4
- 1/8
- 1/16

In the dihybrid cross described in the text, which of the following represents a gamete that could be produced by an F₁ (YyRr) plant?

- YY
- Rr
- YR
- RR



Probability

The inheritance of genes can be compared to the probability of flipping a coin, as shown in Figure 9. The probability of the coin landing on heads is 1 out of 2, or $1/2$. If the same coin is flipped twice, the probability of it landing on heads is $1/2$ each time or $1/2 \times 1/2$, or $1/4$ both times.

Actual data might not perfectly match the predicted ratios. You know that if you flip a coin twice you might not get heads 1 out of the 2 times. You might get heads twice, or you might get tails twice. However, the more times you flip the coin, the closer your results will be to the predicted ratio of heads to tails. Mendel's experimental results were not exactly a 9:3:3:1 ratio. However, the larger the number of offspring involved in a cross, the more likely it will match the results predicted by the Punnett square.



Figure 9 The probability of inheritance of genes can be modeled by flipping a coin.

5. MATH Connection What is the probability of rolling a 2 on a six-sided die? What is the probability of rolling two 2s on two six-sided dice? How is probability used in the study of genetics?

What is the probability of flipping a coin and getting heads?

- a. $1/4$ b. $1/2$ c. $3/4$ d. $1/1$

If you flip a coin twice, what is the probability of getting heads both times?

- a. $1/4$ b. $1/2$ c. $3/4$ d. $1/1$

Why might actual genetic data not perfectly match predicted ratios?

- a. Because Mendel's experiments were flawed
b. Because probability only works with large sample sizes
c. Because the Punnett square method is outdated
d. Because genetic inheritance follows different rules than coin flips

What happens to experimental results as the number of offspring in a genetic cross increases?

- a. They become less predictable
b. They match predicted ratios more closely
c. They follow a completely different pattern
d. They show more genetic mutations

What is the probability that a cross between a heterozygous dominant yellow-seeded pea plant and a green-seeded pea plant will produce green-seeded offspring?

- a. 1:1 b. 1:2 c. 1:4 d. 1:8

If there are five boys and no girls born into a family, what is the probability that the sixth offspring will be a girl?

إذا ولد لعائلة خمس أطفال ذكور ولم يولد لها إناث،
فما احتمال أن يكون المولود السادس أنثى؟

$$\frac{1}{4}$$

$$\frac{1}{2}$$

$$\frac{1}{3}$$

$$\frac{1}{6}$$



What happens to experimental results as the sample size increases in genetic crosses?

- a. They become less predictable
- b. They match the predicted ratios more closely
- c. They always follow exactly a 9:3:3:1 ratio
- d. They become completely random

What is the probability of flipping a coin and getting heads twice in a row?

- a. $1/4$
- b. $1/2$
- c. $3/4$
- d. $1/1$

What is the probability of rolling a 2 on a six-sided die?

- a. $1/3$
- b. $1/6$
- c. $1/2$
- d. $2/6$

If the probability of inheriting a dominant allele is $1/2$, what is the probability of inheriting two dominant alleles from both parents?

- a. $1/4$
- b. $1/2$
- c. $1/3$
- d. $1/1$

How does Mendel's observed ratio compare to the theoretical Punnett square predictions?

- a. His results always matched the predicted ratios exactly
- b. His results showed no correlation to the predicted ratios
- c. His results did not exactly match the predicted ratios but approached them with larger sample sizes
- d. His results consistently showed a perfect 9:3:3:1 ratio

What is the probability of rolling two 2s on two six-sided dice?

- a. 1 in 36
- b. 1 in 6
- c. 2 in 6
- d. 1 in 12

How is probability used in the study of genetics?

- a. To determine the exact traits an offspring will have
- b. To predict the likelihood of inheriting specific traits
- c. To eliminate recessive traits from a population
- d. To measure the speed of genetic mutations

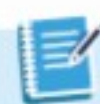
In a monohybrid cross between two heterozygous parents ($Aa \times Aa$), what is the probability of producing an offspring with the recessive phenotype?

- a. 1 in 4
- b. 3 in 4
- c. 1 in 2
- d. 1 in 3

Which mathematical tool is commonly used to visualize genetic probability?

- a. Venn diagram
- b. Punnett square
- c. Bar graph
- d. Line chart

7	BIO.3.1.03.038: Explain the phases of meiosis in terms of cell division, the movement of chromosomes, and crossing over of genetic material.	CROSSING OVER	12
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Get It?

Analyze the effect of crossing over on linked genes.

Chromosome maps

Crossing over occurs more frequently between genes that are far apart than those that are close together. A drawing called a chromosome map shows the sequence of genes on a chromosome and can be created by using crossover data. The very first chromosome maps were published in 1913 using data from thousands of fruit fly crosses.

Figure 11 shows the first chromosome map created using fruit fly data. Recall that the higher the crossover frequency, the farther apart the two genes are. Genes that are closer together have a lower frequency of crossing over. In the example below, the genes for yellow body and white eyes are close together on the map because they show a low frequency of crossing over.

Which statement is not true of genes located close together on the same chromosome?

- They are linked together.
- They always segregate independently.
- They do not segregate independently.
- They travel together during gamete formation.

Two rabbits that were homozygous for both coat and eye color were crossed. The following are the phenotypes of their F2 generation. Which most strongly suggest that the genes for eye color and coat color are linked?

- 22 brown coat brown eye, 7 brown coat blue eye, 9 white coat blue eye, 4 white coat blue eye
- 62 brown coat brown eye, 21 brown coat blue eye, 18 white coat blue eye, 7 white coat blue eye
- 92 brown coat brown eye, 35 brown coat blue eye, 31 white coat blue eye, 11 white coat blue eye
- 95 brown coat brown eye, 12 brown coat blue eye, 16 white coat blue eye, 30 white coat blue eye

The pair of genes that are less likely to be separated during crossing over is:

- A and B
- B and A
- A and C
- B and C



The pair of genes that are most likely to be separated during crossing over is:

- A and B
- B and A
- A and C
- B and C

A geneticist crossed fruit flies to determine whether two traits are linked. The geneticist crossed a fly with blistery wings and spineless bristles (*bbss*) with a heterozygous fly that had normal wings and normal bristles (*BbSs*). Which results in the next generation would suggest these traits are linked?

- 35 normal wings, normal bristles, 28 normal wings, spineless bristles, 23 blistery wings, normal bristles, 30 blistery wings, spineless bristles
- 105 normal wings, normal bristles, 101 normal wings, spineless bristles, 111 blistery wings, normal bristles, 115 blistery wings, spineless bristles
- 198 normal wings, normal bristles, 200 normal wings, spineless bristles, 185 blistery wings, normal bristles, 189 blistery wings, spineless bristles
- 222 normal wings, normal bristles, 27 normal wings, spineless bristles, 22 blistery wings, normal bristles, 228 blistery wings, spineless bristles



Why do linked genes usually travel together during meiosis?

- b. They are located on different chromosomes
- c. They are far apart on the same chromosome
- d. They are close together on the same chromosome
- e. They are dominant traits

What did studies using fruit flies (*Drosophila melanogaster*) reveal about linked genes?

- a. Linked genes always travel together during meiosis
- b. Linked genes can separate during crossing over
- c. Linked genes mutate during meiosis
- d. Linked genes follow Mendel's law of independent assortment

How does crossing over contribute to genetic variation?

- a. It eliminates recessive traits
- b. It swaps sections of chromosomes during meiosis
- c. It prevents gene linkage
- d. It duplicates chromosomes

Why do linked genes violate Mendel's law of independent assortment?

- a. They are inherited randomly
- b. They segregate independently
- c. They are always dominant
- d. They tend to be inherited together

What does a chromosome map show?

- a. The number of chromosomes in a cell
- b. The frequency of mutations
- c. The sequence and relative positions of genes based on crossover data
- d. The dominant and recessive traits in an organism

How does crossing over affect the inheritance of linked genes?

- a. It ensures linked genes are always inherited together
- b. It can separate linked genes, increasing genetic variation
- c. It eliminates recessive alleles
- d. It prevents dominant traits from being expressed



8 BIO.3.1.03.038: Explain the phases of meiosis in terms of cell division, the movement of chromosomes, and crossing over of genetic material.

FIGURE 11

12

Chromosome maps

Crossing over occurs more frequently between genes that are far apart than those that are close together. A drawing called a chromosome map shows the sequence of genes on a chromosome and can be created by using crossover data. The very first chromosome maps were published in 1913 using data from thousands of fruit fly crosses.

Figure 11 shows the first chromosome map created using fruit fly data. Recall that the higher the crossover frequency, the farther apart the two genes are. Genes that are closer together have a lower frequency of crossing over. In the example below, the genes for yellow body and white eyes are close together on the map because they show a low frequency of crossing over.

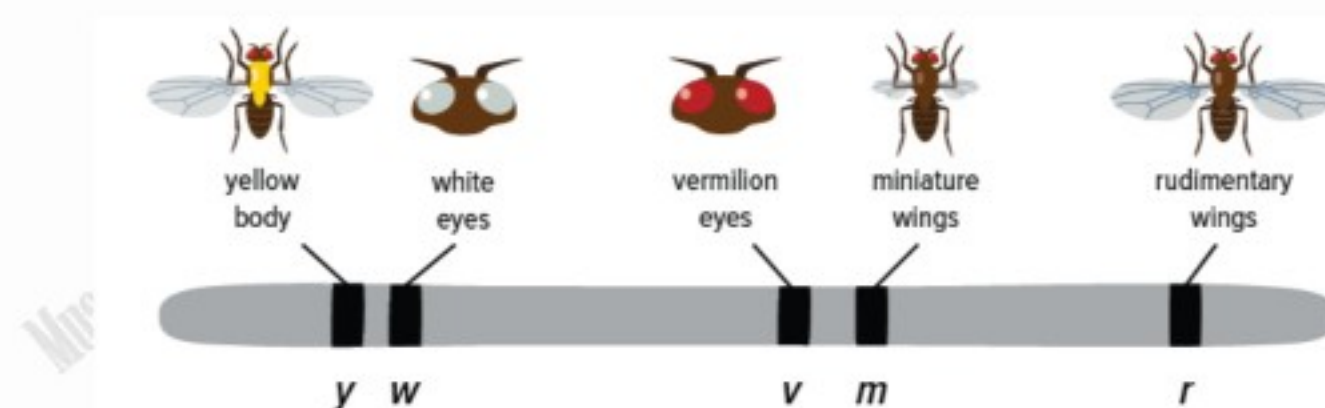
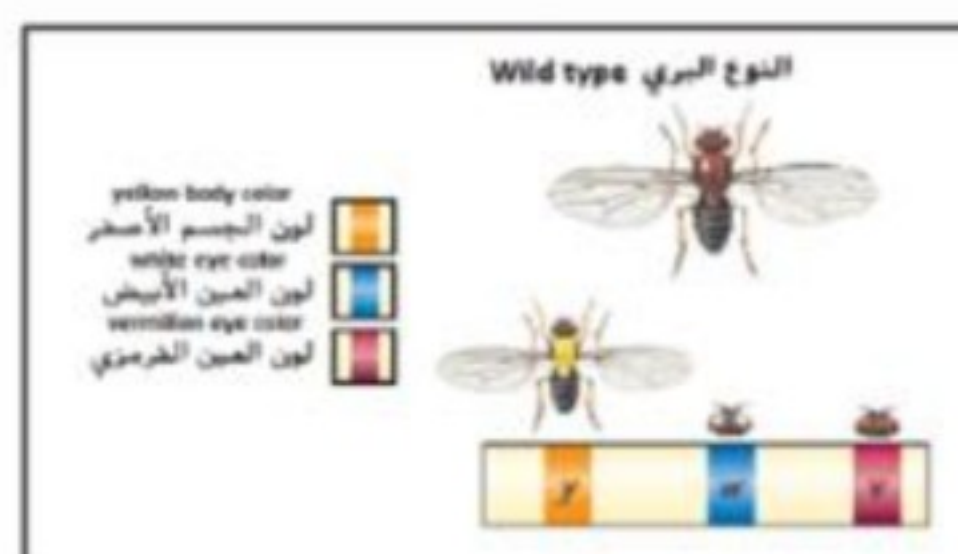


Figure 11 This chromosome map of the X chromosome of the fruit fly *Drosophila melanogaster* was created in 1913.

MOE-Q: The Figure below shows the first chromosome map created using Fruit fly data. What are the genes *y*, *w*, *v* called?

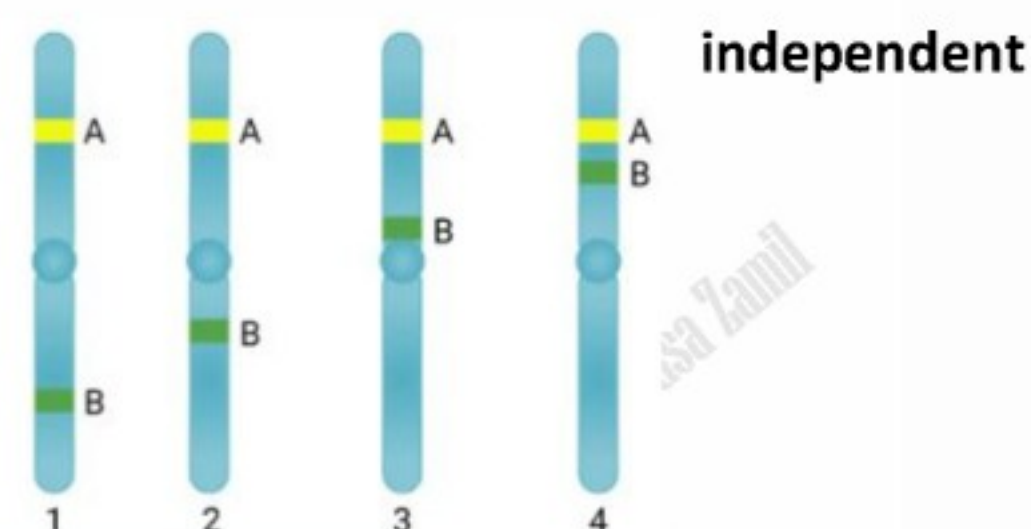
- The linked genes
- The independently genes
- The dominant genes
- The recessive genes



created using

The pair of linked genes that are least likely to follow Mendel's law of assortment are in figure.

- 1
- 2
- 3
- 4



The linkage of genes on a chromosome results in an exception to Mendel's law of independent assortment because:

- linked genes usually do not segregate independently.
- linked genes usually segregate independently.
- Linked genes usually travel separately during meiosis
- Linked genes can not separate during crossing over

Which of the linked genes have the lowest recombination frequency?

- A and C
- A and B
- A and D
- C and D



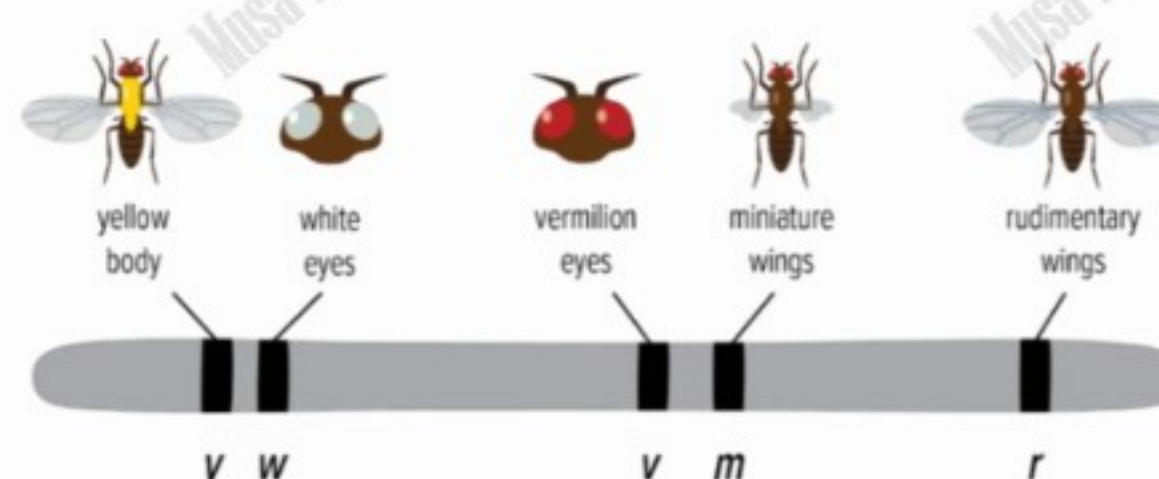
Using the data of table, the order of genes on the chromosome map:

- ABCD
- BDCA
- BACD
- DABC

Linked genes	Recombination frequency
A-B	2%
A-C	12%
C-D	13%
B-D	25%

Based on the chromosome map shown, which two alleles least frequency of crossing over?

- r* and *y*
- r* and *w*
- y* and *w*
- y* and *m*



have the



A typical crossing experiment involving three genes in fruit flies might show the percentage of recombinant, or crossover offspring, between the genes taken in pairs to be the following:

frequency between A and G = 5%

frequency between G and M = 21%

frequency between A and M = 16%

Use these numbers to order the genes on the most reasonable genetic map and indicate the number of map units between them.

- A -5 units- G -16 units- M
- G -5 units- A -16 units- M
- G -16 units- A -5 units- M
- G -21 units- A -5 units- M

What does the frequency of crossing over indicate about the distance between genes on a chromosome?

- Higher crossover frequency indicates genes are closer together
- Higher crossover frequency indicates genes are farther apart
- Crossover frequency has no relation to gene distance
- Crossover frequency only relates to gene function, not position

Which statement is not true of genes located close together on the same chromosome?

- They are linked together.
- They always segregate independently.
- They do not segregate independently.
- They travel together during gamete formation.

Why are the genes for yellow body and white eyes close together on the map?

- Because they control similar physical traits
- Because they show a high frequency of crossing over
- Because they show a low frequency of crossing over
- Because they were discovered at the same time

What is the primary purpose of a chromosome map?

- To show the physical appearance of chromosomes
- To show the sequence of genes on a chromosome
- To show which genes are most important
- To show how genes evolve over time

What does a chromosome map represent?

- The number of chromosomes in a cell
- The physical size of each chromosome
- The sequence and relative positions of genes based on crossover frequency
- The dominant and recessive traits of an organism

What is the relationship between crossover frequency and gene distance?

- Genes that are closer together have higher crossover frequency
- Genes that are farther apart have lower crossover frequency
- Genes that are farther apart have higher crossover frequency
- Crossover frequency is unrelated to gene distance



Polyploidy

Most species have diploid cells, but some have polyploid cells. **Polyploidy** is the occurrence of one or more extra sets of all chromosomes in an organism. A triploid organism, for instance, would be designated $3n$, which means that it has three complete sets of chromosomes. Polyploidy rarely occurs in animals. In humans, polyploidy is always lethal.

Roughly one in three species of known flowering plants are polyploid. Polyploid plants are often selected for by plant growers for their desirable characteristics, such as large flowers. Commercially grown bread wheat ($6n$), oats ($6n$), sugar cane ($8n$), and strawberries ($8n$) are polyploid crop plants. Polyploid plants, such as the one that produced the coffee shown in Figure 12, often have increased vigor and larger size.



Figure 12 Various commercial plants, such as coffee, are polyploids.



Get It?

Explain why plant growers often select for polyploid plants.

What does the term "polyploidy" refer to?

- The loss of chromosomes during cell division
- The presence of one or more extra sets of all chromosomes
- The mutation of genes on a chromosome
- The fusion of two different species

Which of the following crops is polyploid?

- Corn ($2n$)
- Bread wheat ($6n$)
- Rice ($2n$)
- Barley ($2n$)

MOE-Q: Which of the following species used in agriculture is most likely a polyploid?

- Caw
- Goat
- Hin
- Wheat

Why are polyploid plants often favored by growers?

- They are easier to genetically modify
- They produce smaller fruits
- They have increased vigor and larger size
- They require less water

Which of the following statements about polyploidy in animals is correct?

- Polyploidy commonly occurs in most animal species
- Polyploidy in humans is rarely lethal
- Polyploidy rarely occurs in animals
- Most animals are naturally polyploid

Why might plant growers select for polyploid plants?

- They require less water and nutrients
- They have increased vigor and larger size
- They are more resistant to all diseases
- They have shorter growing seasons



10	Explain that in artificial selection, humans have the capacity to influence certain characteristics of organisms through selective breeding	SELECTIVE BREEDING	14
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Selective Breeding

You might be familiar with different breeds of dogs, such as Saint Bernards, huskies, and German shepherds. Observe some of the phenotypic traits of these breeds in Figure 13. All three have strong, muscular bodies. Saint Bernards have traits such as a keen sense of smell that make them good rescue dogs. Huskies are endurance runners and pull sleds long distances. German shepherds are highly trainable for special services. Since ancient times, humans have bred animals with certain traits to obtain offspring that have desired traits. As a result, these traits become more common. Breeding for desired traits is not restricted to animals alone. Plants also are bred to produce desired traits, such as larger fruits and shorter growing times. The process by which desired traits of certain plants and animals are selected and passed on to their future generations is called **selective breeding**. Through the processes of hybridization and inbreeding, desired traits can be passed on to future generations.



Figure 13 Dogs have traits that make them suited for different tasks: Saint Bernard—keen sense of smell; husky—endurance to run long distances; and German shepherd—high trainability.

traits and transferring them to future generations called?

Which is an example of selective breeding?

- Crossing two plants with desirable traits
- Inserting genes from one plant into another
- Returning bred plants to their natural habitat
- Produce larger fruits and having shorter growing times

What is the process of selecting desirable

- Hybridization
- Selective breeding
- in breeding
- Test cross

MOE-Q: Dogs have traits that make them suited for different tasks. Which trait makes German shepherd In the figure below suitable for his tasks?

- Endurance to run long distances
- High trainability
- Keen sense of Smell
- Keen sense of hear



German shepherd
Service dog
الخدمة
كلب الخدمة

the

MOE-Q: Dogs have traits that make them suited for different tasks. Which trait makes in the figure below suitable for his police tasks?

- Endurance to run long distances
- Shepherd—high trainability
- Keen sense of hear
- Keen sense of Smell



Beagle - Detective dog
البيغل
كلب بوليسي

the Beagle



Which statement is not true about selective breeding.

- a. Selective breeding uses technology that involves manipulating the DNA of one organism in order to insert exogenous DNA.
- b. As a result of long-term selective breeding certain traits become more common.
- c. Selective breeding is used on both plants and animals.
- d. Since ancient times, humans have bred animals with certain traits to obtain offspring that have desired traits.

What is the main goal of selective breeding?

- a. To increase genetic diversity
- b. To eliminate all recessive traits
- c. To produce offspring with desired traits
- d. To prevent evolution

Which of the following is an example of a trait selected through breeding in Saint Bernards?

- a. Ability to fly
- b. Keen sense of smell
- c. Bright colored fur
- d. High-pitched bark

How does selective breeding affect the frequency of desired traits?

- a. It makes traits disappear over time
- b. It causes traits to mutate randomly
- c. It makes desired traits more common
- d. It prevents traits from being inherited

Which process is used in selective breeding to combine traits from different organisms?

- a. Mutation
- b. Hybridization
- c. Cloning
- d. Photosynthesis

Why might plant growers use selective breeding?

- a. To reduce fruit size
- b. To increase growing time
- c. To produce larger fruits and shorter growing cycles
- d. To eliminate all plant traits

بطاقة الأحياء صف 12 متقدم شرح أ. مومس زامل



جاهز للنجاح وإطلاق إبداعاتك

فيديوهات ▶ ملازم شرح ▶ أوراق عمل ▶ اختبارات

مراجعة تفصيلية شاملة للهيكل

للاشتراك في البطاقة واتساب الدعم
الفني للأكاديمية 0569174493



11	BIO.3.2.04.010: Explain that in artificial selection, humans have the capacity to influence certain characteristics of organisms through selective breeding.	HYBRIDIZATION	15
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Hybridization

Crossing parent organisms with different forms of a trait to produce offspring with specific traits results in hybrids. Farmers, animal breeders, scientists, and gardeners often use the production of hybrids, also known as hybridization. They select traits that will give hybrid organisms a competitive edge, such as disease-resistance or faster growth. For example, plant breeders might choose to cross two different varieties of tomato plants in order to produce a hybrid that has both the disease resistance of one parent and the fast growth rate of the other parent.

Care must be taken to cross organisms to yield the right combination of traits from both parents. A disadvantage of hybridization is that it is time consuming and expensive. For example, it took rice breeders three decades to produce hybrid rice varieties that can produce higher yields than nonhybrid varieties. Because hybrids can be bred to be more nutritious, to have the ability to adapt to a wide range of changes in the environment, and to produce greater numbers of offspring, the advantages of hybridization sometimes outweigh the disadvantages.

What do we call the process that involves the crossing between living organisms that have different characteristics to produce members of a generation that possesses certain competitive characteristics?

- a. Hybridization b. Selective breeding c. In breeding d. Test cross

In the field of agriculture, hybridization is commonly employed to create new plant varieties. Which of the following but describes the outcome of hybridization in this context?

- a. The resulting plants are genetically identical to their parent plants.
b. The resulting plants often have reduced resistance to pests and diseases.
c. The resulting plants exhibit a combination of desirable traits from the parent plants.
d. The resulting plants are always sterile and cannot produce seeds.

MOE-Q: In the field of agriculture, hybridization is commonly employed to create new plant varieties.

which of the following best describes the outcome of hybridization in this context?

- a. The resulting plants are genetically identical to their parent plants.
b. The resulting plants often have reduced resistance to pests and diseases.
c. The resulting plants exhibits a combination of desirable traits from the parent plants.
d. The resulting plants are always sterile and cannot produce seeds.

Which is the result of crossing parent organisms with different forms of a trait to produce offspring with specific traits?

- a. Transgenic organism b. Transgenic organism c. Hybrid d. Clone

MOE-Q: Which of the following is a disadvantage of hybridization?

- a. Hybridization is harmful to the affected organisms
b. Hybridization is time—consuming and expensive
c. Hybridization is technically difficult to perform
d. Hybridization is inferior to genetic engineering

How are HYBRIDIZATION and INBREEDING similar?

- a. Both are a form of selective breeding.
b. Both are a form of natural selection.
c. Both result in no change in genetic traits.
d. Both involve breeding organisms with similar genetic traits.



Which term describes the process in which people cross parent organisms with different forms of a trait to produce offspring with specific traits?

- a. inbreeding b. pure breeding c. test crossing d. hybridization

What is the main goal of hybridization?

- a. To eliminate all recessive traits
b. To produce offspring with specific desirable traits
c. To clone identical organisms
d. To reduce genetic diversity

Which of the following is an example of a trait selected during hybridization?

- a. Bright-colored petals
b. Disease resistance and fast growth
c. Random mutations
d. Smaller fruit size

What must be considered when performing hybridization?

- a. The cost of fertilizer
b. The genetic similarity of the parents
c. The right combination of traits from both parents
d. The color of the offspring

What is the primary purpose of hybridization as described in the text?

- a. To decrease the cost of agricultural production
b. To produce organisms with specific desired traits
c. To increase the genetic diversity of wild populations
d. To eliminate harmful genes from a population

Which of the following is an example of hybridization?

- a. Creating disease-resistant wheat
b. Developing drought-tolerant corn
c. Breeding faster-growing cattle
d. Crossing tomato plants for disease resistance and growth rate

Which of the following is NOT a potential benefit of hybridization?

- a. Increased nutritional value
b. Greater adaptability to environmental changes
c. Higher reproduction rates
d. Extended shelf life of produce

Get It?

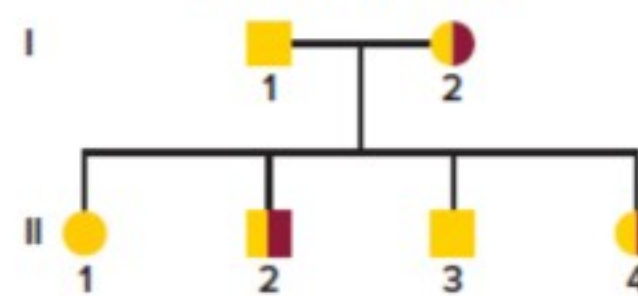
Explain how symbols are used to represent individuals in a pedigree.

Key to Symbols

- Normal female
- Female who expresses the trait being studied
- Female who is a carrier for the particular trait

- Normal male
- Male who expresses the trait being studied
- Male who is a carrier for the particular trait

Example Pedigree



○ □ homozygous dominant

● ■ homozygous recessive

| Generation

— Parents

≡ Siblings

Roman numerals — Generations

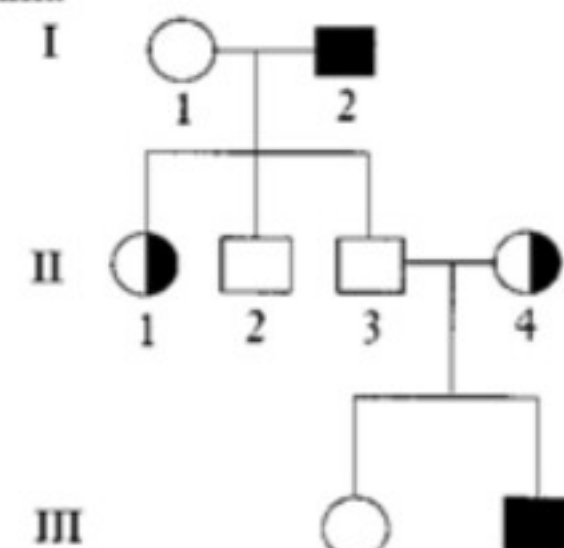
Arabic numerals — Individuals in a certain generation

Figure 15 A pedigree uses standard symbols to indicate what is known about the trait being studied.

Summarize the genotypes and phenotypes of the individuals in generation II for the trait being studied.

For the trait being followed in the pedigree below, individuals II-1 and II-4 can be classified as ____.

Incidence of Hemophilia



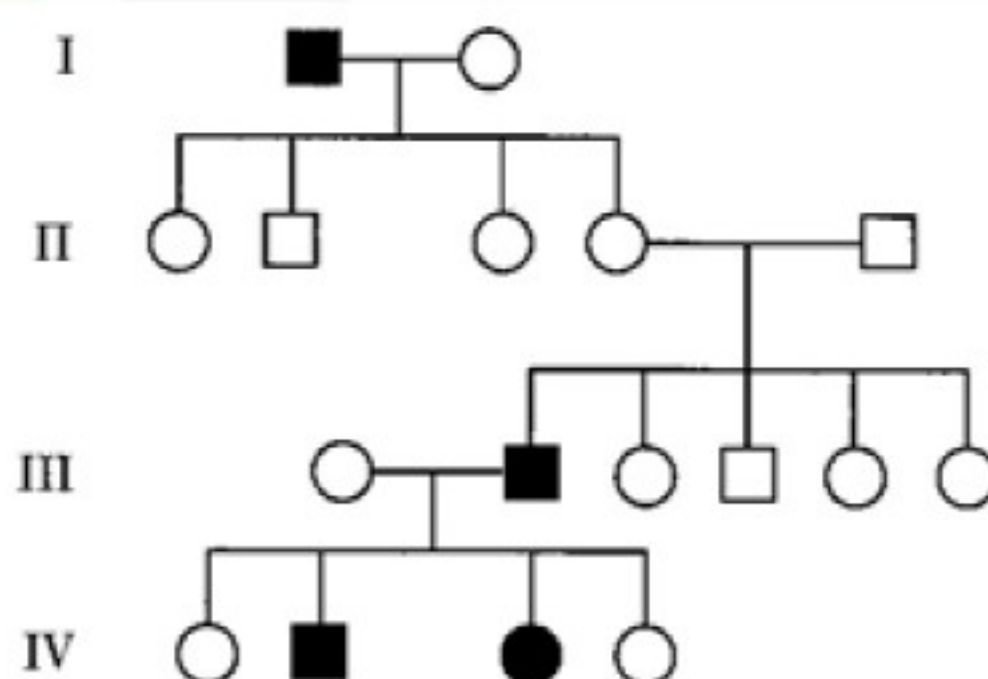
a. homozygous dominant

b. mutants

c. homozygous recessive

d. carriers

Based on Figure below, what do you know about individual III-2's mother?

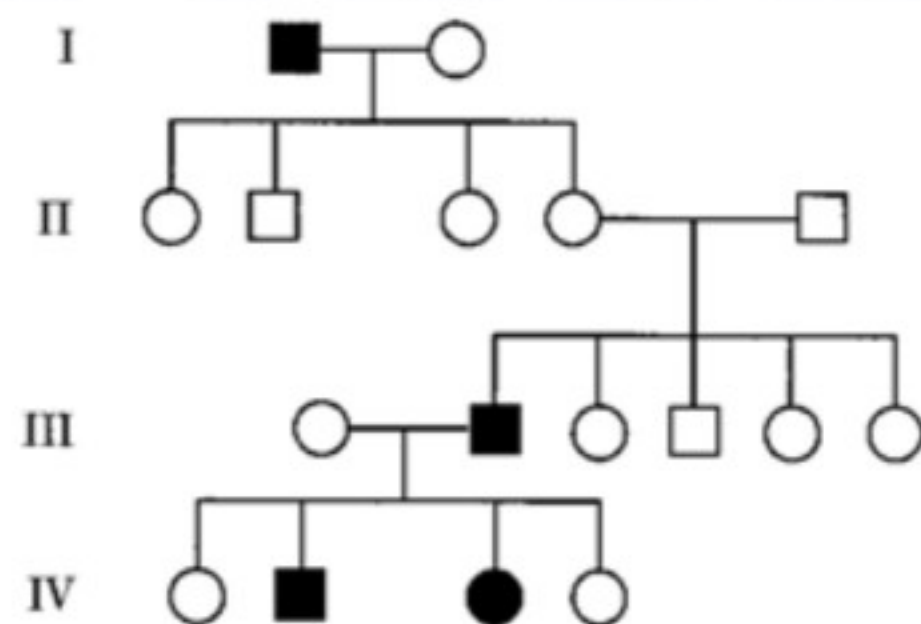


a. She had the trait.

b. She was a carrier.

c. She was homozygous recessive.

d. She was homozygous dominant.



According to the pedigree in Figure above, how many of the offspring in the III generation show the normal trait?

a. 1 b. 2

c. 4 d. 5

You and your colleagues are constructing a pedigree for a boy with cystic fibrosis. The individual's younger brother has also been diagnosed with cystic fibrosis. How would these brothers be represented in a pedigree?

a. Both would be represented as completely shaded circles.

b. Both would be represented as completely shaded squares.

c. The older brother would be a shaded square, while the younger brother would be a half-shaded square.

d. Both would be represented as unshaded squares.



In a pedigree diagram, what symbol is used to represent a female who expresses the trait being studied?

- a. Unfilled circle b. Filled circle c. Unfilled square d. Filled square

How are generations represented in a pedigree diagram?

- a. By Arabic numerals
b. By Roman numerals
c. By alphabetical letters
d. By geometric shapes

In a pedigree diagram, what does a horizontal line between two symbols represent?

- a. Siblings b. Siblings c. Parents d. Individuals who express trait

What does a half-filled symbol in a pedigree represent?

- a. An individual who partially expresses the trait
b. An individual whose trait status is unknown
c. A carrier for the particular trait
d. An individual who is affected by multiple traits

What is the purpose of a pedigree in genetics?

- a. To measure chromosome length
b. To trace the inheritance of a trait through generations
c. To identify dominant traits only
d. To determine the number of chromosomes in a person

What does a filled symbol (square or circle) indicate in a pedigree?

- a. The individual is deceased
b. The individual expresses the trait being studied
c. The individual is a carrier of the trait
d. The individual has no known traits

How are parents and offspring connected in a pedigree?

- a. By vertical lines only
b. By dashed lines
c. By a horizontal line between parents and vertical lines to offspring
d. By arrows pointing to each child

What does the label "II1" mean in a pedigree?

- a. First individual in generation I
b. Firstborn in generation II
c. Second individual in generation I
d. First individual with the trait



13 BIO.3.3.01.036: Investigate that variations of inherited traits between parent and offspring arise from genetic differences that result either from the subset of chromosomes and therefore from inherited genes or rarely from mutations and show the variations of inherited traits in a pedigree.

FIGURE 16

19

Recessive genetic disorders

A pedigree illustrating Tay-Sachs disease is shown in Figure 16. Tay-Sachs disease is a recessive genetic disorder caused by the lack of an enzyme involved in lipid metabolism. The missing enzyme causes lipids to build up in the central nervous system, which can lead to death.

Examine the pedigree in Figure 16. Note that two unaffected parents, I1 and I2, have an affected child—II3, indicating that each parent has one recessive allele—they both are heterozygous and carriers for the trait. The half-filled square and circle show that both parents are carriers.

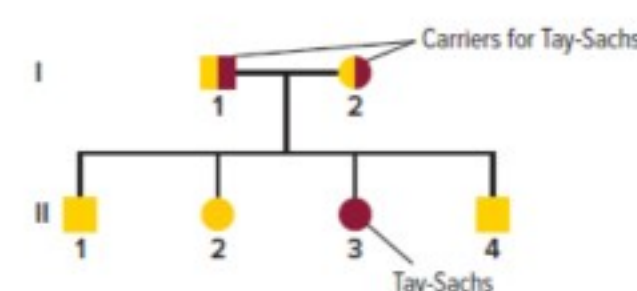


Figure 16 This pedigree illustrates the inheritance of the recessive disorder Tay-Sachs disease. Note that two unaffected parents (I1 and I2) can have an affected child (II3).

An individual with Tay-Sachs disease would be identified by which symptom?

- excessive mucus production
- an enlarged liver
- a cherry-red spot on the back of the eye
- vision problems

Which is the genotype of a person who is a carrier for a recessive genetic disorder?

- DD
- Dd
- dd
- dE

In this pedigree, which family members are carriers of Tay-Sachs?

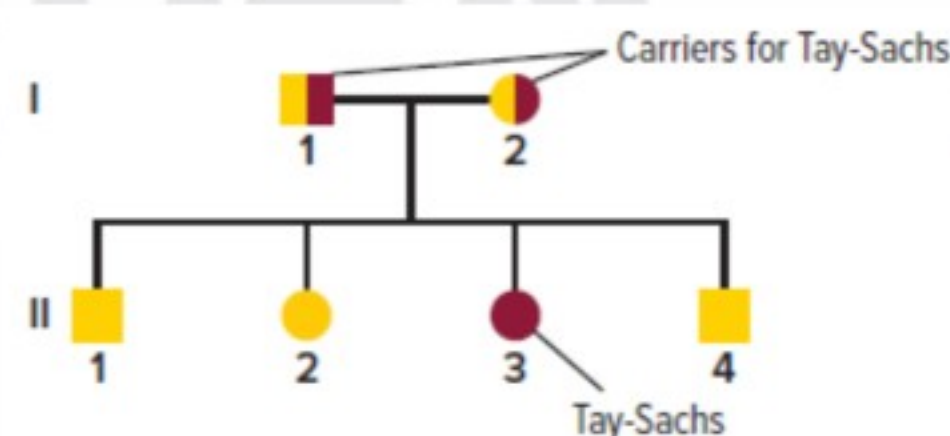
- both parents
- first and second offspring
- second and fourth offspring
- mother only

How is it possible that one of the children in this pedigree expresses Tay-Sachs?

- carrier parents passed both recessive alleles
- parents expressed the disease
- child was infected by siblings
- child is heterozygous dominant

MOE-Q: Based on the pedigree in Figure, what genetic pattern is the inheritance of Tay-Sachs disease?

- Autosomal dominant inheritance
- X-linked recessive inheritance
- Autosomal recessive inheritance
- X-linked dominant inheritance



illustrated by

In the pedigree, individuals I1 and I2 are both carriers for Tay-Sachs disease. What is the probability that their next child will have Tay-Sachs disease?

- 100%
- 50%
- 25%
- 0%

Tay-Sachs disease is caused by:

- An excess of an enzyme involved in lipid metabolism
- A lack of an enzyme involved in lipid metabolism
- An excess of lipids in the bloodstream
- A lack of lipids in the central nervous system

If two carriers of Tay-Sachs disease ($Tt \times Tt$) have children, what percentage of their offspring would be expected to be carriers but not affected by the disease?

- 100%
- 50%
- 25%
- 0%

14

BIO.3.3.01.036: Investigate that variations of inherited traits between parent and offspring arise from genetic differences that result either from the subset of chromosomes and therefore from inherited genes or rarely from mutations and show the variations of inherited traits in a pedigree.

INFERRING GENOTYPES

20

Inferring genotypes

Pedigrees are used to infer genotypes from the observation of phenotypes. By knowing physical traits, genealogists can determine what genes an individual is most likely to have. Phenotypes of entire families are analyzed in order to determine family genotypes.

Pedigrees help genetic counselors determine whether inheritance patterns are dominant or recessive. Once the inheritance pattern is determined by analyzing the available information, the genotypes of the individuals can largely be resolved, or identified, through pedigree analysis.

To analyze pedigrees, one particular trait is selected to be studied, and a determination is made as to whether that trait is dominant or recessive. Dominant traits are easier to recognize than recessive traits because dominant traits are exhibited in the phenotype of individuals.

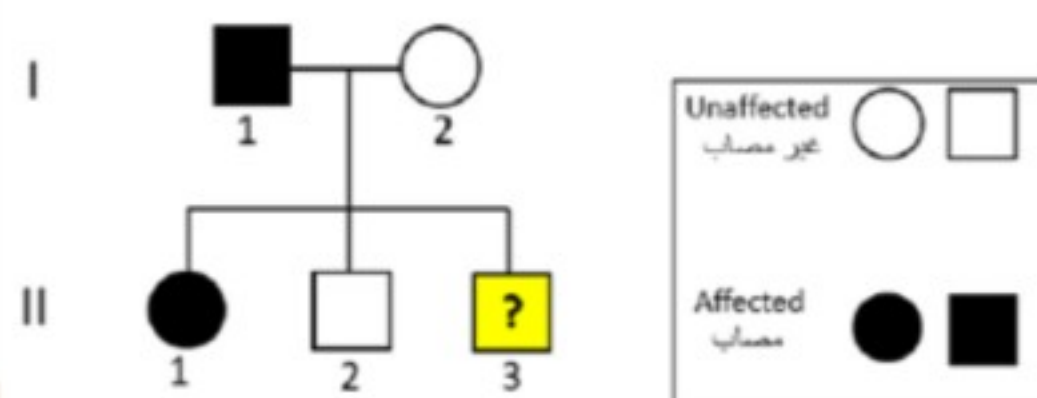
A recessive trait will not be expressed unless the person is homozygous recessive for the trait. That means that a recessive allele is passed on by each parent. When recessive traits are expressed, the ancestry of the person expressing the trait is followed for several generations to determine which parents and grandparents were carriers of the recessive allele.



Get It?

Analyze What can be determined about the genotypes of the parents of an individual who expresses a recessive trait?

MOE- Q: The pedigree below illustrates the inheritance of a **dominant disorder** across two generations. The parents I(1) and I(2) had II(3) and they wanted to know if this child could be affected by Huntington's disease or not. Based on the pedigree, predict the genotype(s) of the child II (3).



dominant
the child

possible

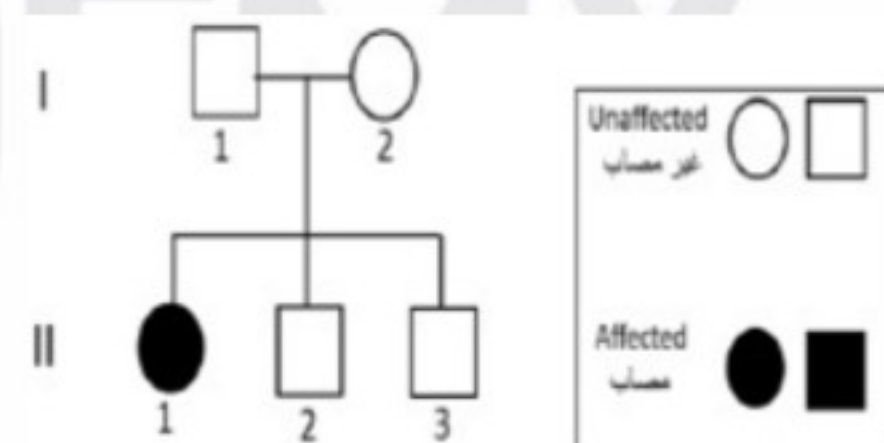
a. Hh only

b. HH only

c. Hh or hh

d. hh only

MOE- Q: The pedigree below illustrates the inheritance of a **recessive disorder** of a disease. Based on the pedigree, predict the possible genotypes of the (1) and I (2)?



disorder
parents I

- The genotypes of both parents are aa
- The genotype of I(1) is aa and that of II(2) is AA
- The genotype of I(1) is Aa and that of II(2) is AA
- The genotypes of both parents are Aa

USE THE PEDIGREE BELOW TO ANSWER THE NEXT TWO QUESTIONS

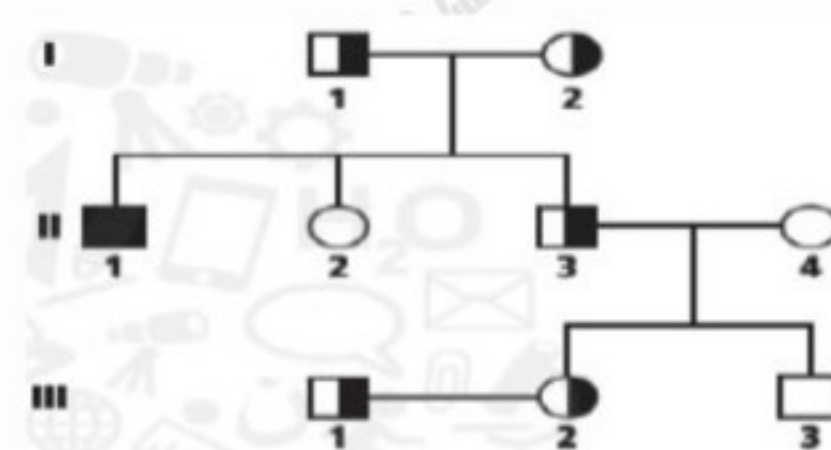
Which disease develop the person could symptoms of that is tracked in the pedigree?

- I1
- II1
- II2
- III2

According to the pedigree, who is a carrier and cannot have children with the disease?

A. 11 n_ iii C. 113 D. 1111

- I1
- II1
- II3
- III1



Use Figure 2 to Identify the genotypes of the following individuals: I2

- heterozygous dominant
- heterozygous dominant
- homozygous recessive
- heterozygous dominant

Use Figure 2 to Identify the genotypes of the following individuals: II2

- heterozygous dominant
- heterozygous dominant
- homozygous recessive
- heterozygous dominant

Use Figure 2 to Identify the genotypes of the following individuals: II3

- heterozygous dominant
- heterozygous dominant
- homozygous recessive
- heterozygous dominant

Use Figure 2 to Identify the genotypes of the following individuals: II4.

- heterozygous dominant
- heterozygous dominant
- homozygous recessive
- heterozygous dominant

Use Figure 2 to Identify the second-generation females who are homozygous recessive for this disorder.

- I3 and I6
- I1 and I4
- II3 and II6
- II1 and II4

Interpret What are the genotypes of the parents in this diagram?

- Both parents are homozygous dominant and do not carry the Tay-Sachs allele.
- Both parents are homozygous recessive and affected by Tay-Sachs disease.
- Both parents are carriers of the disease and are heterozygous for Tay-Sachs disease.
- One parent is a carrier and the other is affected by Tay-Sachs disease

Interpret If a person who does not carry the Tay-Sachs disease gene marries offspring II4, what are the possible genotypes for their children?

- All children will be affected by Tay-Sachs disease.
- All children will be carriers or affected by the disease.
- The children would either be homozygous for not having the gene or heterozygous carriers of the disease.
- The children would either be homozygous for having the gene or heterozygous carriers of the disease.

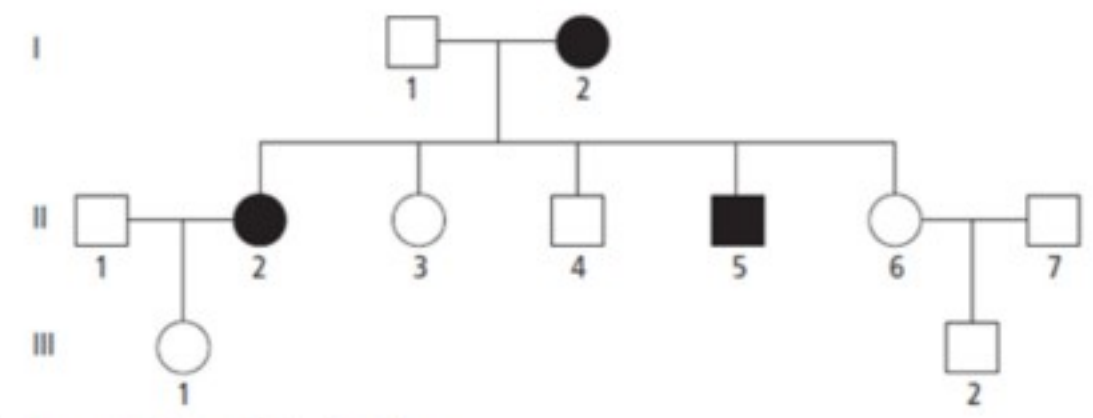


Figure 2 Polydactyly Disorder Pedigree

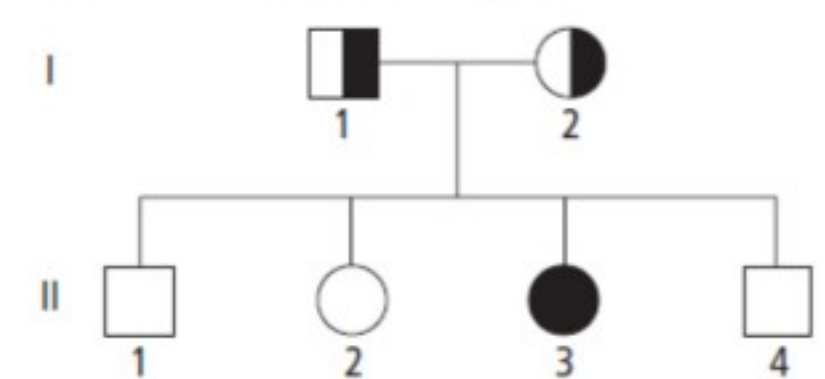


Figure 1 Tay-Sachs Disease Pedigree

15 BIO.3.3.01.036: Investigate that variations of inherited traits between parent and offspring arise from genetic differences that result either from the subset of chromosomes and therefore from inherited genes or rarely from mutations and show the variations of inherited traits in a pedigree.

DOMINANT GENETIC DISORDERS

22

Types of Dominant Genetic Disorders

Some human disorders, such as the rare disorder Huntington's disease, are caused by dominant alleles. That means those who do not have the disorder are homozygous recessive for the trait. Review Table 3 as you read about several dominant genetic disorders that occur in humans.

Table 3 Dominant Genetic Disorders in Humans

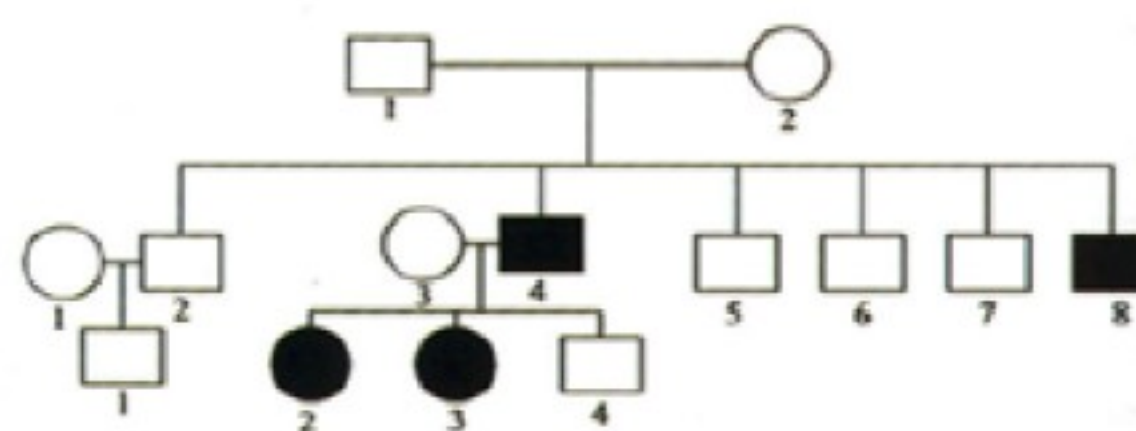
Disorder	Occurrence in the U.S.	Cause	Effect	Cure/Treatment
Huntington's disease	1 in 10,000	A gene affecting neurological function is defective.	- Decline of mental and neurological functions - Ability to move deteriorates	No cure or treatment
Achondroplasia	1 in 25,000	A gene that affects bone growth is abnormal.	- Short arms and legs - Large head	No cure or treatment

MOE- Q: Which of the following genetic disorders cannot be represented by the inheritance pattern shown in the pedigree below?

- Galactosemia
- Tay-Sachs's disease
- Cystic fibrosis
- Achondroplasia

Which condition is inherited as a dominant allele?

- albinism
- cystic fibrosis
- Tay-Sachs disease
- Huntington's disease

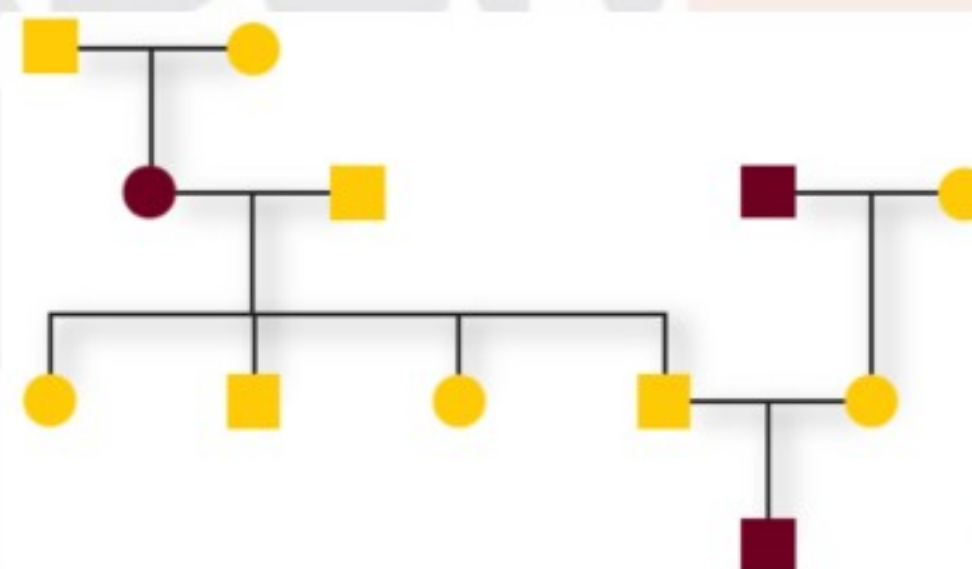


MOE- Q: Which of the following is not a characteristic of a person with Huntington's disease?

- A gradual loss of brain function
- Uncontrollable movements
- Emotional disturbances
- Vision problems

Which disorder could not follow the inheritance pattern shown?

- cystic fibrosis
- albinism
- Tay-Sachs disease
- Huntington's disease

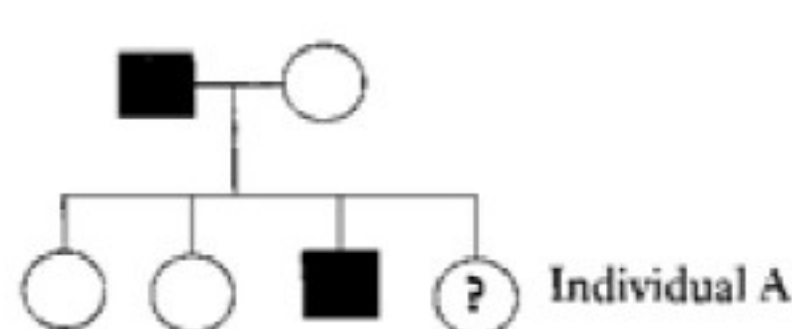


A man carrying the allele for Huntington's disease marries a woman who is homozygous recessive for the allele. What is the probability that their offspring will develop Huntington's disease?

- 25 percent
- 50 percent
- 75 percent
- 100 percent

According to Figure below, what is the chance that individual A will be afflicted with Huntington's?

Incidence of Huntington's Disease



□ ○ Unaffected individuals
■ ● Affected individuals

- 25%
- 50%
- 75%
- 100%



What is a characteristic of dominant genetic disorders?

- a. They only affect individuals who are homozygous for the trait
- b. They require both parents to have the disorder
- c. They can affect individuals who have only one copy of the allele
- d. They always skip generations

Which of the following is true about achondroplasia?

- a. It is a recessive genetic disorder
- b. It results in a shortened life expectancy
- c. It is the most common form of dwarfism
- d. It cannot be detected before birth

When a child with achondroplasia is born to parents of average size, what is the most likely explanation?

- a. Both parents must be carriers of the recessive gene
- b. A new mutation has occurred
- c. The trait skipped the previous generation
- d. The condition was environmentally induced

What type of allele causes Huntington's disease?

- a. Recessive allele
- b. Dominant allele
- c. Sex-linked allele
- d. Codominant allele

Which genotype would a person without Huntington's disease most likely have?

- a. Homozygous dominant
- b. Heterozygous
- c. Homozygous recessive
- d. Hemizygous

What are common symptoms of Huntington's disease?

- a. Short limbs and small body size
- b. Gradual loss of brain function, uncontrollable movements, and emotional disturbances
- c. Vision loss and hearing impairment
- d. Muscle hypertrophy and increased reflexes

What is the most common form of dwarfism mentioned in the text?

- a. Tay-Sachs disease
- b. Huntington's disease
- c. Achondroplasia
- d. Marfan syndrome

Why are most individuals with achondroplasia born to parents of average size?

- a. The condition is recessive and skips generations
- b. It is caused by environmental factors
- c. It results from a new mutation or genetic change
- d. It is inherited only from the mother

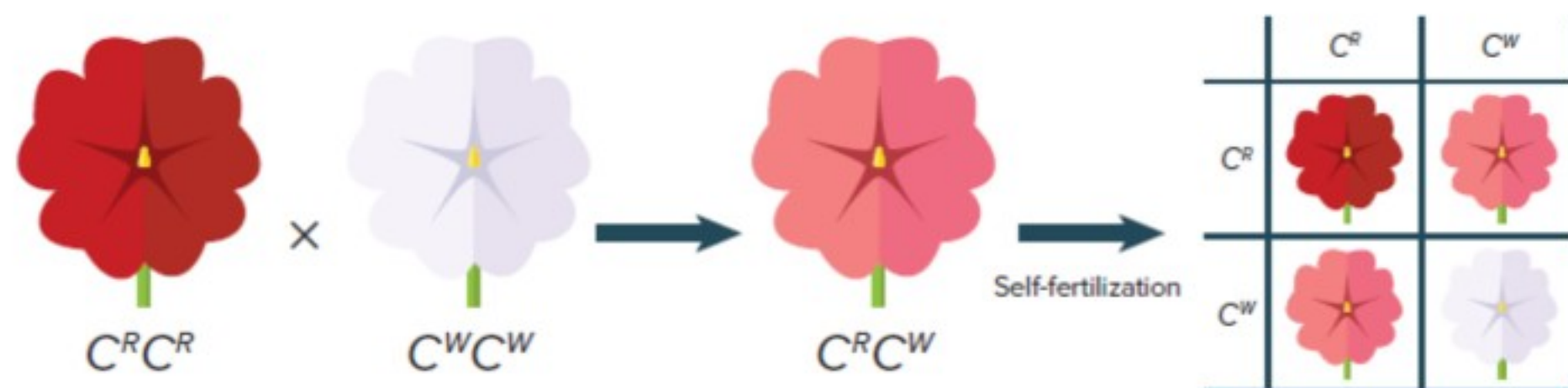


Figure 18 The color of snapdragon flowers is a result of incomplete dominance. When a plant with white flowers is crossed with a plant with red flowers, the offspring have pink flowers. Red, pink, and white offspring will result from self-fertilization of a plant with pink flowers.

Predict what would happen if you crossed a pink-flowered snapdragon with a white-flowered snapdragon. Identify the genotypes and phenotypes possible in the offspring.

MOE-Q: The table below shows the cross of two snapdragons plants, one white flowered ($C^W C^W$) and the pink flowered ($C^R C^W$). Which of the following ratios the phenotypes of the offspring?

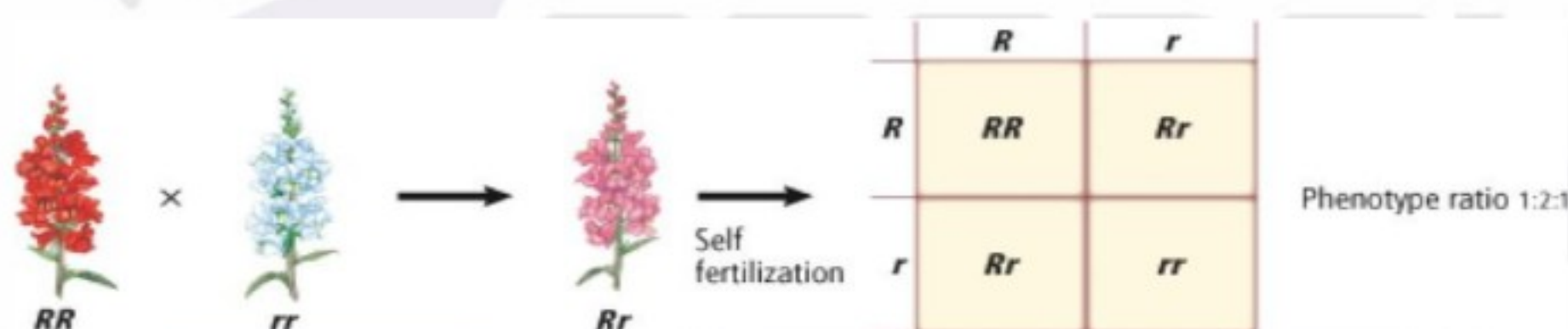
	C^W	C^W
C^R	$C^R C^W$	$C^R C^W$
C^W	$C^W C^W$	$C^W C^W$

R: Red أحمر
W: White أبيض

other describes

- 2:2 red: white
- 1:1:1 red: pink: white
- 1:2:1 red: pink: white
- 2:2 pink: white

MOE-Q: This Punnett square shows incomplete dominance in snap dragons. What do the Rr alleles represent?



- an example of codominance
- homozygous intermediate traits
- heterozygous intermediate traits
- homozygous recessive traits

In radishes, color is controlled by incomplete dominance, where homozygous dominant radishes are red, homozygous recessive are white, and the intermediate radishes are purple. What phenotypic would you expect from crossing two heterozygous plants?



radishes ratios

- 1:1:1 red: purple :white
- 3:1 red: white
- 1:2:1 red: purple: white
- 2:2 red: white



White-flowered plants crossed with red-flowered plants to produce pink-flowered offspring is an example of

- a. complete dominance
- b. codominance
- c. incomplete dominance
- d. dominance

MOE-Q: In a population of chickens, feather color is determined by a single gene with two alleles: B (for black feathers) and W (for white feathers). When a homozygous black-feathered chicken (BB) is crossed with a homozygous white-feathered chicken (WW), the offspring have feathers that are a blend of black and white, resulting in a blue appearance (BW). What phenotypic ratios would you expect from crossing two heterozygous chicken?

- a. 2 black: 2 white
- b. 1 black: 1 blue: 1 white
- c. 1 black: 2 blue: 1 white
- d. 2 blue: 2 white



White-flowered plants crossed with red-flowered plants to produce pink-flowered offspring is an example of

- a. codominance.
- b. complete dominance.
- c. dominance.
- d. incomplete dominance.

MOE-Q: The color of snapdragon flowers is the result of incomplete dominance. When a plant with white flowers is crossed with a plant with red flowers, the offspring have pink flowers. Which of the following represent the predicted phenotypic ratio of the offspring's resulting from crossing two **heterozygous** snapdragon plants?

- a. 2 red: 2 white
- b. 1 red: 1 pink: 1 white
- c. 1 red: 2 pink: 1 white
- d. 2 pink : 2 white



Your Guide to Success



SEM Magnification: unavailable



Magnification: unavailable

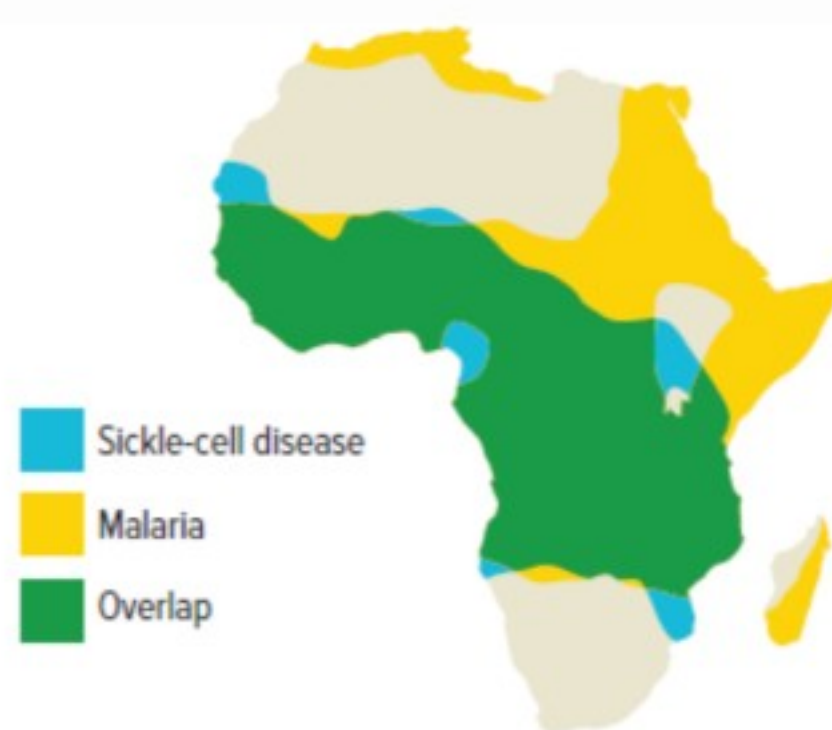


Figure 19

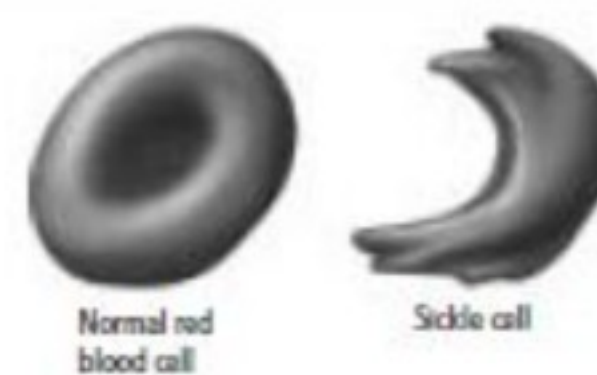
Top: Normal red blood cells are flat and disk-shaped.

Middle: Sickle-shaped cells are elongated and/or C-shaped. They can clump, blocking circulation in small vessels.

Bottom: The sickle-cell allele increases resistance to malaria.

Study the blood cells in the picture below. Describe the genotype for the individual with these types of cells.

- homozygous recessive
- heterozygous
- homozygous dominant
- codominant



What is codominance in genetics?

- When one allele is completely dominant over another
- When both alleles are expressed equally in the heterozygous condition
- When neither allele is expressed in the heterozygous condition
- When an allele is only expressed in homozygous individuals

In sickle-cell disease, what is affected by the genetic mutation?

- White blood cells
- Platelets
- Hemoglobin in red blood cells
- Bone marrow production

What is the characteristic shape of red blood cells in individuals with sickle-cell disease?

- Square-shaped
- Flat and disk-shaped
- Elongated and/or C-shaped
- Triangular-shaped

Approximately what percentage of African Americans have some form of the sickle-cell trait?

- 5 percent
- 9 percent
- 15 percent
- 25 percent



What health problem is caused by sickle-shaped blood cells?

- a. They cannot carry enough oxygen
- b. They cause excessive bleeding
- c. They block circulation in small blood vessels
- d. They multiply too rapidly

How do individuals who are heterozygous for the sickle-cell trait typically live?

- a. They experience severe symptoms and shortened lifespans
- b. They have no symptoms whatsoever
- c. They experience moderate symptoms that worsen with age
- d. They can lead relatively normal lives as normal cells compensate for sickle cells

What relationship exists between sickle-cell disease and malaria in Africa?

- a. They have no geographical correlation
- b. Areas with high rates of sickle-cell disease have lower rates of malaria
- c. Areas with high rates of sickle-cell disease have higher rates of malaria
- d. The sickle-cell trait only appears in areas without malaria

Why has the sickle-cell allele persisted in populations from central Africa?

- a. It provides complete immunity to all diseases
- b. It has no negative health effects in these populations
- c. It provides resistance to malaria, increasing survival rates
- d. It improves oxygen transport in high-altitude regions

What is the genetic pattern of inheritance for sickle-cell disease?

- a. Sex-linked recessive
- b. Codominant
- c. Completely dominant
- d. Incomplete dominance

What happens in individuals who are heterozygous for the sickle-cell trait?

- a. All of their red blood cells are sickle-shaped
- b. None of their red blood cells are affected
- c. They have both normal and sickle-shaped red blood cells
- d. Their red blood cells alternate between normal and sickle shapes

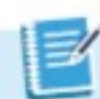
Multiple Alleles

Not all traits are determined by two alleles. Some forms of inheritance are determined by more than two alleles. This is referred to as **multiple alleles**. An example of such a trait is human blood group.

Blood groups in humans

The ABO blood group, shown in Figure 20, has three forms of alleles, sometimes called AB markers: I^A is blood type A; I^B is blood type B; and i is blood type O. Type O is the absence of AB markers. Individuals with blood type O have the genotype ii .

Note that allele i is recessive to I^A and I^B . However, I^A and I^B are codominant. Blood type AB results when an individual inherits both an I^A allele and an I^B allele. Therefore, the ABO blood group is an example of both multiple alleles and codominance.



Get It?

Explain how genetic traits carried on multiple alleles can lead to a wide range of characteristics in humans.

The Rh blood group includes Rh factors, inherited from each parent. Rh factors are either positive or negative (Rh+ or Rh-); Rh+ is dominant and Rh- is recessive. The Rh factor is a blood protein named after the rhesus monkey because studies of the rhesus monkey led to discovery of that blood protein.

Human blood groups are determined by

- the removal of all alleles
- single alleles
- chromosome inactivation
- multiple alleles

MOE- Q: In humans, three alleles affect blood type: I^A , I^B and i . Which of the following is NOT true?

- The I^A and I^B alleles are codominant because both alleles are simultaneously expressed in heterozygote
- Human blood type is an example of multiple allele inheritance
- Human blood type is an example of complete dominance because the allele i is recessive to the alleles I^A and I^B
- The I^A and I^B alleles are a case of incomplete dominance because both alleles are simultaneously expressed in heterozygote

A father with type A+ blood and a mother with type O+ blood have four children. Of their four children, two have type A+ blood and two have type O+ blood. What is the genotype of the father?

- $I^A i$
- $I^A I^A$
- ii
- $I^A I^B$

An individual has type AB blood. His father has type A blood and his mother has type B blood. What is the individual's phenotype an example of?

- simple recessive heredity
- simple dominant heredity
- incomplete dominance
- codominance

Which of the following illustrates the genotype of a male of blood group (A) and having the hemophilia disease? Select two correct answers from the choices below:

- $X^H X^h ii$
- $X^H Y I^A i$
- $X^h X^h I^B i$
- $X^h Y I^A I^A$
- $X^h Y I^A i$

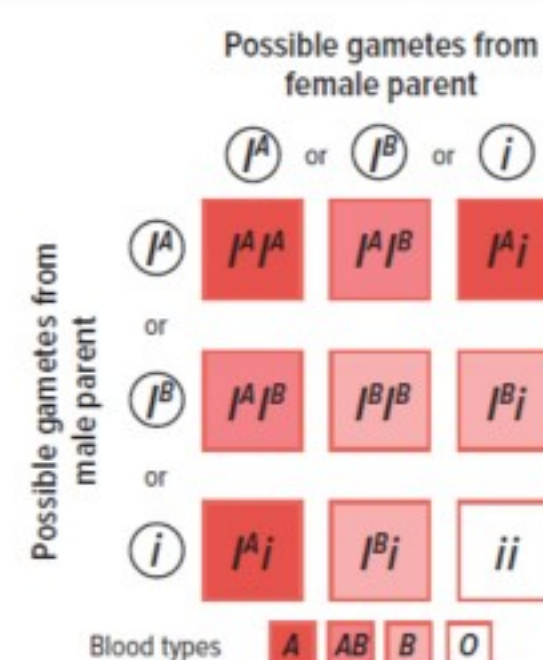


Figure 20 There are three forms of alleles in the ABO blood group— I^A , I^B , and i . I^A and I^B are codominant. i is recessive to both I^A and I^B .



A family has four children, whose blood types are A, B, AB, and O. What are the possible blood types of the parents?

- a. A and O b. O and B c. B and AB d. A and B

If the father's blood type is $I^A i$ and the mother's is $I^B i$, what is the probability of having a child with type O blood?

- a. $1/2$ b. $1/4$ c. $3/4$ d. $2/3$

Which of the following illustrates the genotype of a male of blood group (B) and not having hemophilia disease?

- a. $X^H X^h I^B I^B$ b. $X^h X^h I^B i$ c. $X^H Y I^B I^B$ d. $X^H Y I^B i$

Which two terms best describe the inheritance of human blood types?

- a. incomplete dominance and codominance
b. codominance and multiple alleles
c. incomplete dominance and multiple alleles
d. codominance and epistasis

An individual has type AB blood. His father has type A blood and his mother has type B blood. What is the individual's phenotype an example of?

- a. simple recessive heredity
b. simple dominant heredity
c. incomplete dominance
d. codominance

A man heterozygous for blood type A marries a woman heterozygous for blood type B. The chance that their first child will have type O blood is ____.

- a. 0% b. 25%
c. 50% d. 75%

MOE-Q: In humans, three alleles affect blood type: I^A , I^B and i . Which of the following is NOT true?

- a. The I^A and I^B alleles are codominant because both alleles are simultaneously expressed in heterozygote
b. Human blood type is an example of multiple allele inheritance
c. Human blood type is an example of complete dominance because the allele i is recessive to the alleles I^A and I^B
d. The I^A and I^B alleles are a case of incomplete dominance because both alleles are simultaneously expressed in heterozygote

MOE-Q: If the father's blood type is $I^A i$ and the mother's is $I^B i$, what is the probability of having a child with type O blood?

- a. $1/4$ b. $1/3$ c. $2/3$ d. 1

MOE-Q: A father with type A+ blood and a mother with type O+ blood have four children. Of their four children, two have type A+ blood and two have type O+ blood. What is the genotype of the father?

- a. $I^A i$ b. $I^A I^A$ c. ii d. $I^A I^B$



19	BIO.3.3.01.023: Identify examples, using information collected from printed and electronic resources, of the qualities that depend on the amount of protein produced, which in turn depends on the number of copies of a specific version of the gene, and predict to explain how the imbalance of the lack or presence of one copy or two copies of a specific version of the gene may affect the expression of a particular trait.	GET IT	28
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Dosage Compensation

Human females have 22 pairs of autosomes and one pair of X chromosomes. Males have 22 pairs of autosomes, along with one X and one Y chromosome. The X chromosome is larger than the Y chromosome. The X chromosome carries a variety of genes that are necessary for the development of both females and males. The Y chromosome mainly has genes that relate to the development of male characteristics.

Because females have two X chromosomes, it seems as though females get two doses of the X chromosome and males get only one dose. To balance the difference in the dose of X-related genes, one of the X chromosomes stops working in each of the female's body cells. This often is called dosage compensation or X-inactivation. Which X chromosome stops working in each body cell is a completely random event. Dosage compensation occurs in all mammals.

As a result of the Human Genome Project, the National Institutes of Health (NIH) has released new information on the sequence of the human X chromosome. Researchers now think that some genes on the inactivated X chromosome are more active than was previously thought.



Get It?

Summarize dosage compensation and its effects.

- a. Gene duplication
- b. Chromosome fusion
- c. Dosage compensation
- d. Genetic recombination

MOE-Q: The figure below shows a Calico cat coat (A) and Himalayan rabbit coat (B). Which of the following patterns describes the inheritance of coat color in the calico cats and the rabbit?

- a. Multiple Alleles, (B) Epistasis
- b. Chromosomes inactivation, (B) Multiple Alleles
- c. Epistasis, (B) Polygenic Traits
- d. Polygenic Traits, (B) Multiple Alleles



(A)



(B)

What is dosage compensation primarily a response to?

- a. The larger size of the X chromosome compared to the Y chromosome
- b. The difference in the number of X chromosomes between males and females
- c. The random inactivation of genes on the Y chromosome
- d. The Human Genome Project's findings

Based on recent findings from the Human Genome Project, what have researchers discovered about genes on the inactivated X chromosome?

- a. They are completely inactive in all cases
- b. They are more active than previously thought
- c. They cause genetic disorders in females
- d. They are transferred to the Y chromosome

Why is dosage compensation biologically important?

- a. It prevents males from developing female characteristics
- b. It ensures equal expression of X-linked genes between males and females
- c. It increases genetic diversity in the population
- d. It allows the Y chromosome to develop properly

بطاقة الأحياء صف 12 متقدم شرح أ. مومس زامل



جاهز للنجاح وإطلاق إبداعاتك

فيديوهات ▶ ملازم شرح ▶ أوراق عمل ▶ اختبارات

مراجعة تفصيلية شاملة للهيكل

للاشتراك في البطاقة واتساب الدعم
الفني للأكاديمية 0569174493

20	BIO.3.3.01.023: Identify examples, using information collected from printed and electronic resources, of the qualities that depend on the amount of protein produced, which in turn depends on the number of copies of a specific version of the gene, and predict to explain how the imbalance of the lack or presence of one copy or two copies of a specific version of the gene may affect the expression of a particular trait.	FIGURE 22	28
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Epistasis

Coat color in Labrador retrievers can vary from yellow to black. This is the result of one gene hiding the effects of another gene, an interaction called **epistasis** (ih PIHS tuh sus). A Labrador's coat color is controlled by two sets of alleles. The dominant allele E determines whether the fur will have dark pigment. The fur of a dog with genotype ee will not have any pigment. The dominant B allele determines how dark the pigment will be. Study Figure 22. Genotypes $eebb$, $eeBb$, and $eeBB$ will produce a yellow coat. If the dog's genotype is $Eebb$ or $Eebb$, the dog's fur will be chocolate brown. If the dog's genotype includes at least one E allele and at least one B allele, the fur will be black.



Figure 22 The results of epistasis in coat color in Labrador retrievers show an interaction of two genes, each with two alleles.

The figure below shows animals with different genetics, study them and then answer the question:

Which of the following patterns describes the inheritance of coat color in (A) and (B)?

الشكل أدناه يبين حيوانات ذات صفات وراثية مختلفة، أدرسها جيداً ثم أجب عن السؤال: أي من الأنماط الوراثية التالية تصف وراثية لون الفرو في كل من (A) و (B)؟



(A)
لون الفرو في الأرانب
Coat color of rabbits



(B)
لون الفرو في كلاب لابراڤور
Coat color in Labrador retrievers



(C)
لون فرو قطعة الكاليكو
coat colors of the calico cat

- Dosage Compensation and (B) Multiple Alleles
- Multiple Alleles and (B) Epistasis
- Epistasis and (B) Multiple Alleles
- Polygenic Traits and (B) Dosage Compensation

The coat color in Labrador retrievers is controlled by two sets of alleles. The gene E/e determines whether the fur has pigment or not and is epistatically dominant to the gene B/b , which controls the darkness of pigment when it is there. A breeder crosses a purebred black Lab with the genotype $BBEE$ and a purebred yellow Lab with the genotype $bbee$, producing offspring that are black. A test cross is done between these offspring and an individual with the genotype $bbee$. What is the expected ratio of *black:chocolate:yellow*?

- 1:1:2
- 1:2:1
- 2:1:1
- 2:1:0



What is epistasis?

- a. A genetic condition that causes all Labrador retrievers to have yellow coats
- b. The interaction where one gene masks or modifies the effect of another gene
- c. A rare mutation that only affects black Labradors
- d. The process by which pigment is added to a dog's coat during development

A Labrador with the genotype eeBB will have what coat color?

- a. Black
- b. Chocolate brown
- c. Yellow
- d. yellow and black

Which of the following genotypes would produce a black coat in a Labrador retriever?

- a. eebb
- b. EEbb
- c. eeBB
- d. EeBB

For a Labrador to have a chocolate brown coat, which combination of alleles must be present?

- a. At least one E allele and no B alleles
- b. At least one B allele and no E alleles
- c. Both E and B alleles must be present
- d. Neither E nor B alleles can be present

Based on the information provided, which statement best explains why some Labradors have yellow coats?

- a. The E allele prevents pigment production regardless of the B allele
- b. The B allele always produces yellow pigment when paired with the E allele
- c. The recessive e alleles (ee) prevent any pigment from being produced in the fur
- d. Yellow coat color is only produced when both genes are heterozygous

Which genotype results in chocolate brown fur?

- a. eeBb
- b. EEbb
- c. EEbB
- d. Eebb

What is required for a Labrador to have black fur?

- a. At least one E and one B allele
- b. Homozygous ee genotype
- c. Homozygous bb genotype
- d. Only B allele present



21

BIO.3.3.01.023: Identify examples, using information collected from printed and electronic resources, of the qualities that depend on the amount of protein produced, which in turn depends on the number of copies of a specific version of the gene, and predict to explain how the imbalance of the lack or presence of one copy or two copies of a specific version of the gene may affect the expression of a particular trait.

FIGURE 25

30

Red-green colorblindness

The trait for red-green colorblindness, most commonly, is a recessive X-linked trait. About 8 percent of males in the United States have the trait of red-green color blindness. The right photo in Figure 25 shows how a person with red-green color blindness might view colors compared to the left photo that shows how colors appear to a person who does not have red-green color blindness.

Study the Punnett square shown in Figure 25. The mother is a carrier for color blindness because she has the recessive allele for color blindness on one of her X chromosomes. The father is not color blind because he does not have the recessive allele on his one X chromosome. The sex-linked trait is represented by writing the allele on the X chromosome. Notice that the only offspring that can possibly have red-green color blindness is a male child, and that it is also possible for male offspring of this cross to have normal vision. As a result of it being an X-linked trait, red-green color blindness is very rare in females.



X^B = Normal
 X^b = Red-green color blindness
 Y = Y chromosome

	X^B	Y
X^B	$X^B X^B$	$X^B Y$
X^b	$X^B X^b$	$X^b Y$

Figure 25 People with red-green color blindness view red and green as shades of gray.

Explain why there are fewer females who have red-green color blindness than males.

Why are males more likely to express recessive X-linked traits than females?

- Males have two X chromosomes
- Males have only one X chromosome, so a recessive allele will always be expressed
- Females cannot carry X-linked traits
- X-linked traits are always dominant in males

Red-green color blindness is a recessive X-linked trait. If a mother who is a carrier for color blindness has a child with a father who has normal vision, what is the expected outcome?

- All children will have normal vision
- All sons will be color blind
- 50% of sons could be color blind, while daughters will likely be carriers or have normal vision
- All daughters will be color blind

Which of the following is an example of a trait that appears to be sex-linked but is actually located on an autosome?

- Red-green color blindness
- Male-pattern baldness
- Hemophilia
- Duchenne muscular dystrophy

Why is red-green color blindness rare in females?

- The gene for color blindness does not exist in females
- Females need two copies of the recessive allele to express the trait, which is statistically less likely
- The trait is lethal in females
- Females have stronger color perception genes that override the trait



What are sex-linked traits?

- a. Traits found only in males
- b. Traits controlled by genes on the Y chromosome
- c. Traits controlled by genes on the X chromosome
- d. Traits that affect only reproductive organs

How can a female express a recessive X-linked trait?

- a. If she is heterozygous
- b. If she inherits it from her father only
- c. If she is homozygous recessive
- d. If she has a Y chromosome

How does the baldness allele behave in males and females?

- a. Dominant in both
- b. Recessive in both
- c. Dominant in females, recessive in males
- d. Dominant in males, recessive in females

What is the inheritance pattern of red-green colorblindness?

- a. Autosomal dominant
- b. Y-linked recessive
- c. X-linked recessive
- d. X-linked dominant

Why is red-green colorblindness rare in females?

- a. They have stronger vision
- b. They have only one X chromosome
- c. They must inherit two recessive alleles
- d. They inherit it from their fathers only

In a cross between a carrier mother and a non-colorblind father, which offspring can be colorblind?

- a. Only daughters
- b. Only sons
- c. All children
- d. No children

How do people with red-green colorblindness perceive red and green?

- a. As blue and yellow
- b. As black and white
- c. As shades of gray
- d. As more vibrant colors

22 BIO.3.3.02.017: Explain that environmental factors can influence the probability of occurrences of traits in a population by inducing mutations that are inherited and by affecting the appearance of traits

POLYGENIC TRAITS

32

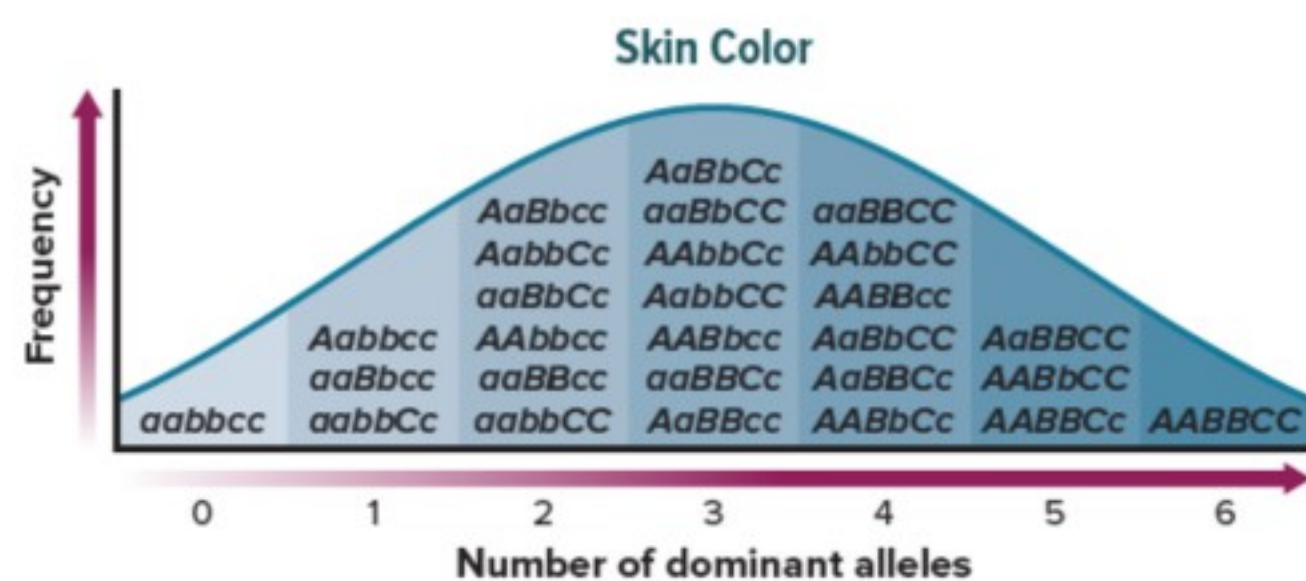


Figure 27 This graph shows possible shades of skin color from three sets of alleles, although the trait is thought to involve more than three sets of alleles.

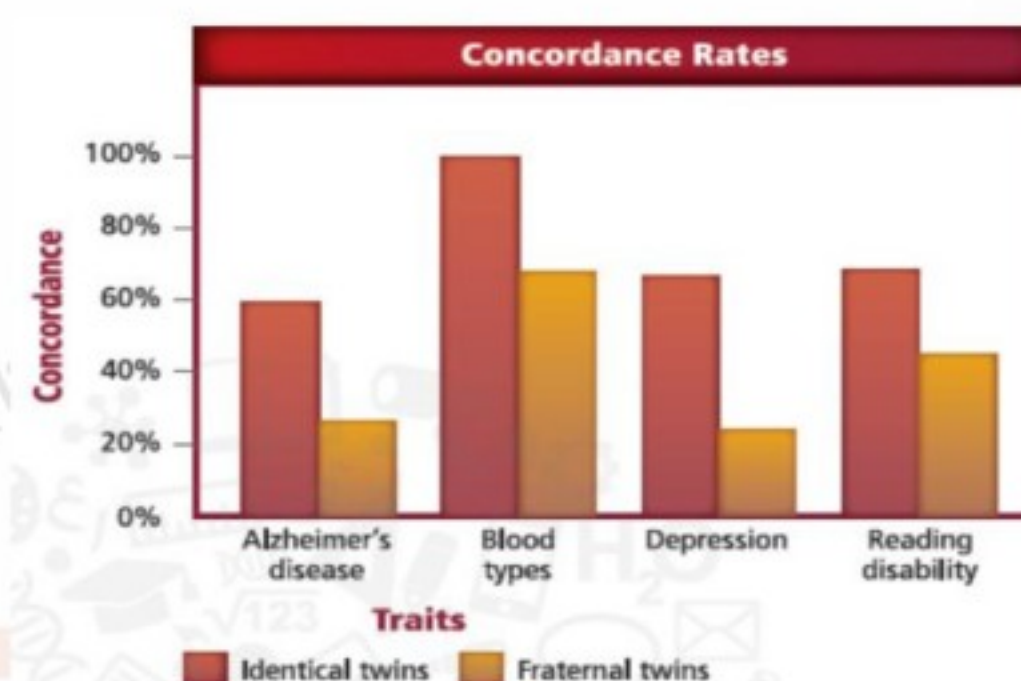
Predict Would more gene pairs increase or decrease the number of possible phenotypes?

Polygenic Traits

You have examined traits determined by a pair of genes. Many phenotypic traits, however, arise from the interaction of multiple pairs of genes. Such traits are called **polygenic traits**. Traits such as skin color, height, eye color, and fingerprint pattern are polygenic traits. One characteristic of polygenic traits is that, when the frequency of the number of dominant alleles is graphed, as shown in Figure 27, the result is a bell-shaped curve. This shows that more of the intermediate phenotypes exist than do the extreme phenotypes.

MOE-Q: The diagram below shows some traits and their concordance rates in identical twins and fraternal twins. Which of the following is shown when a trait is found more often in both members of identical twins than in fraternal twins?

- A strong environmental influence
- No environmental influence.
- No genetic influence.
- A strong genetic influence.



What defines a polygenic trait?

- A trait determined by a single gene
- A trait determined by multiple pairs of genes
- A trait that only appears in certain populations
- A trait that skips generations

When the frequency of dominant alleles in a polygenic trait is graphed, what pattern typically emerges?

- A straight line
- A zigzag pattern
- A bell-shaped curve
- A pyramid shape

Which of the following is NOT an example of a polygenic trait mentioned in the text?

- Skin color
- Height
- Blood type
- Fingerprint pattern



What does the bell-shaped distribution curve of polygenic traits indicate about phenotypes?

- a. Extreme phenotypes are more common than intermediate ones
- b. All phenotypes occur with equal frequency
- c. Intermediate phenotypes are more common than extreme ones
- d. Phenotypes do not follow any predictable pattern

How do polygenic traits differ from traits determined by a single pair of genes?

- a. Polygenic traits are always recessive
- b. Polygenic traits show more continuous variation
- c. Polygenic traits are never influenced by the environment
- d. Polygenic traits are only found in humans

What are polygenic traits?

- a. Traits controlled by a single pair of genes
- b. Traits influenced by environmental factors only
- c. Traits determined by multiple pairs of genes
- d. Traits found only in animals

Which of the following is an example of a polygenic trait?

- a. Blood type
- b. Skin color
- c. Cystic fibrosis
- d. Huntington's disease

What pattern is typically seen when graphing the frequency of dominant alleles in polygenic traits?

- a. Zigzag pattern
- b. Linear increase
- c. Bell-shaped curve
- d. Random scatter

Why do polygenic traits show a bell-shaped curve in frequency graphs?

- a. Because dominant alleles are rare
- b. Because intermediate phenotypes are more common
- c. Because all individuals have the same genotype
- d. Because recessive traits dominate

Which of the following traits is NOT typically polygenic?

- a. Eye color
- b. Height
- c. Fingerprint pattern
- d. Sickle cell anemia



Twin Studies

Identical twins are genetically the same. If a trait is inherited, both twins will have it. Scientists conclude that traits that appear frequently in both identical twins are at least partially due to heredity. Traits expressed differently in identical twins are strongly influenced by environment. The percentage of twins who both express a given trait is called a concordance rate. Figure 29 shows some traits and their concordance rates.

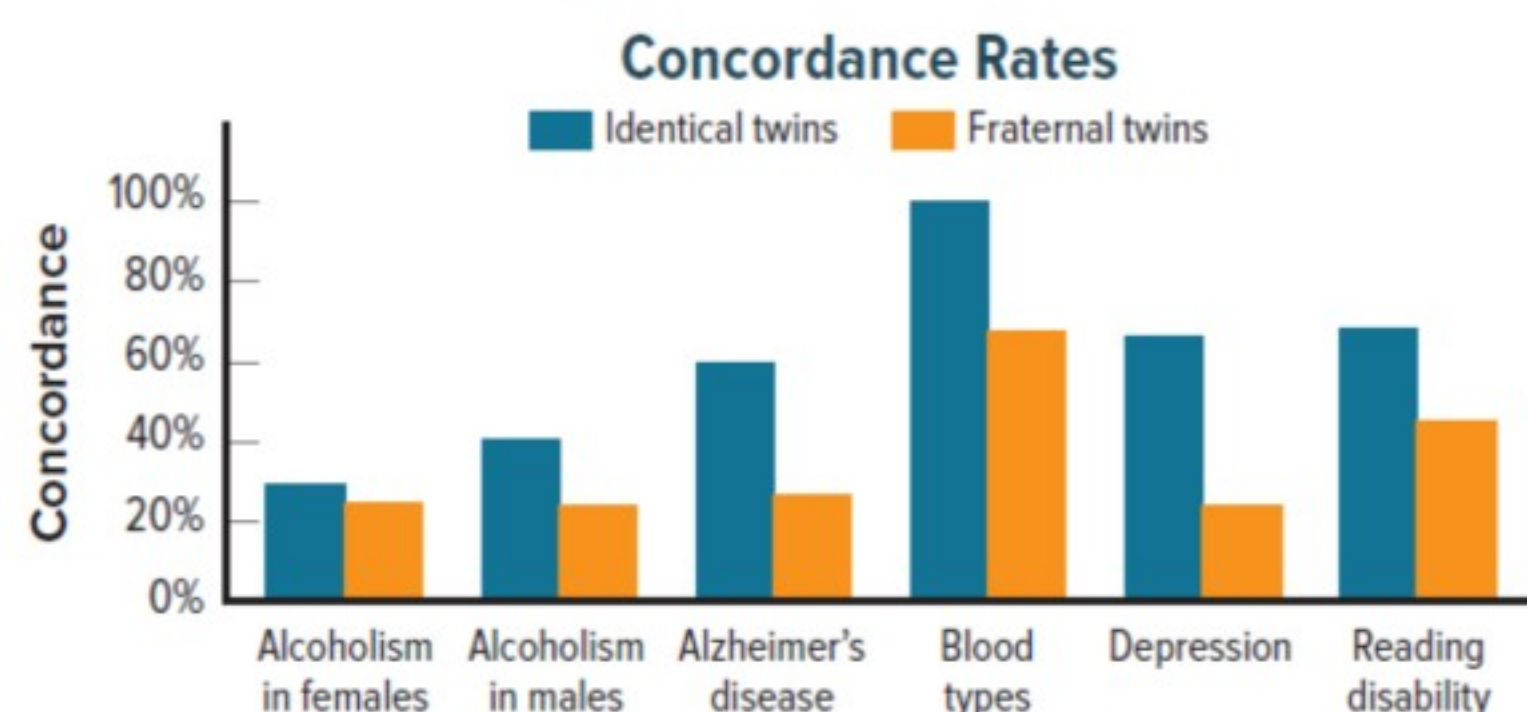


Figure 29 When a trait is found more often in both members of identical twins than in fraternal twins, the trait is presumed to have a significant inherited component.

According to the data in Figure 29, which trait shows a 100% concordance rate in identical twins?

- Depression
- Blood types
- Alcoholism in males
- Alzheimer's disease

What can scientists conclude when a trait appears frequently in both identical twins?

- The trait is completely due to environmental factors
- The trait is completely random
- The trait is at least partially due to heredity
- The trait cannot be studied effectively

The difference between concordance rates in identical twins versus fraternal twins for Alzheimer's disease is:

- 20%
- 30%
- 40%
- 60%

Based on the data provided, which trait shows the greatest difference in concordance rates between identical and fraternal twins?

- Alcoholism in females
- Depression
- Reading disability
- Alzheimer's disease



What does a higher concordance rate in identical twins compared to fraternal twins suggest about a trait?

- a. The trait is exclusively determined by environment
- b. The trait has a significant inherited component
- c. The trait is equally influenced by genetics and environment
- d. The trait cannot be passed to future generations

What does it mean when identical twins both express a trait?

- a. The trait is caused by environmental factors
- b. The trait is likely inherited
- c. The trait is random
- d. The trait is influenced by diet

What are identical twins in terms of genetics?

- a. Genetically different
- b. Genetically similar to fraternal twins
- c. Genetically the same
- d. Genetically opposite

What is the term for the percentage of twins who both express a given trait?

- a. Twin ratio
- b. Genetic index
- c. Concordance rate
- d. Heredity score

If a trait is expressed differently in identical twins, what does that suggest?

- a. The trait is inherited
- b. The trait is influenced by environment
- c. The trait is dominant
- d. The trait is recessive

What conclusion can be drawn if a trait is found more often in identical twins than in fraternal twins?

- a. The trait is likely environmental
- b. The trait is random
- c. The trait has a significant inherited component
- d. The trait is caused by lifestyle choices

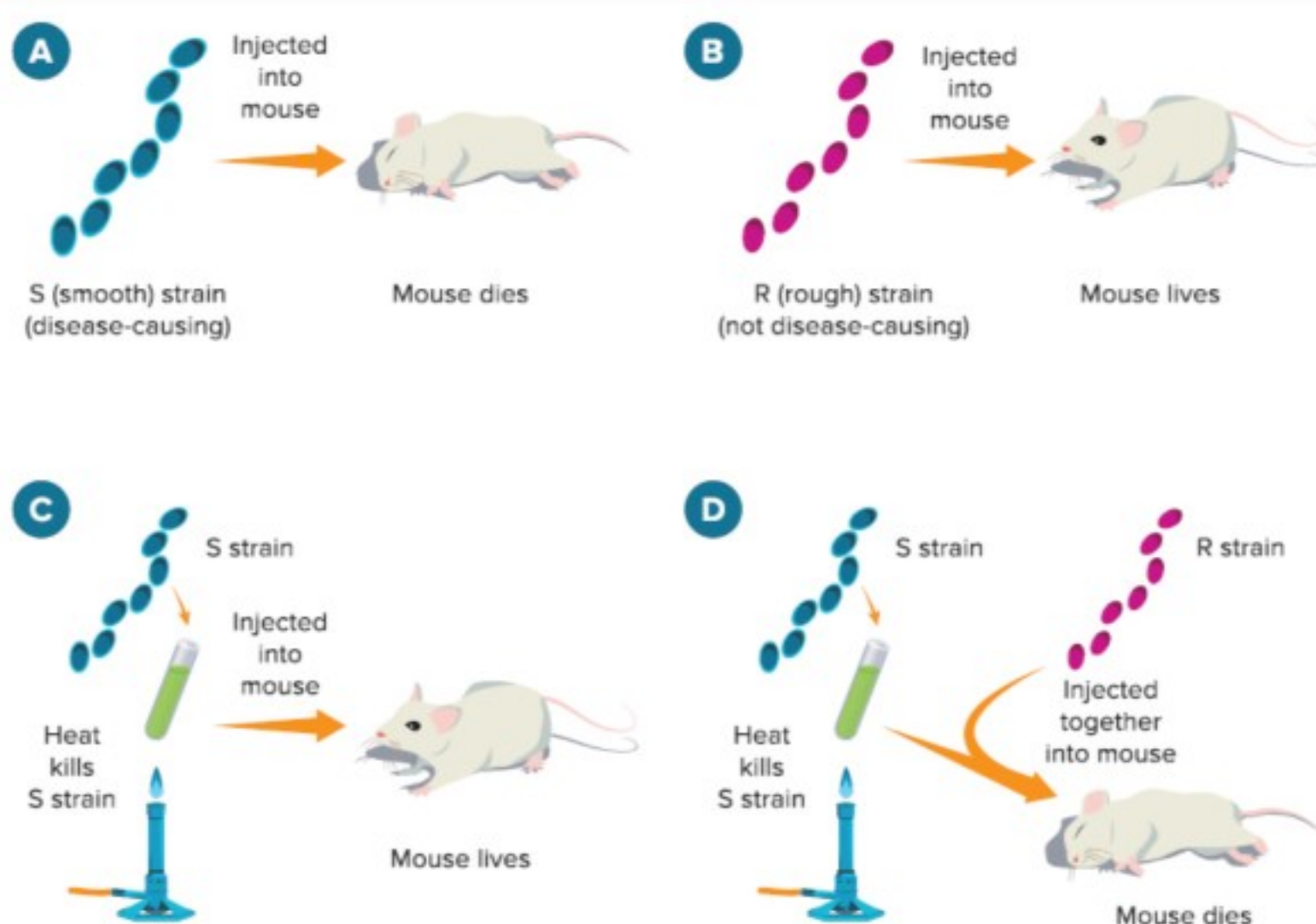


Figure 2 Griffith's transformation experiment demonstrates the change of rough bacteria into smooth bacteria.

Which scientist discovered that the bacteria *Streptococcus pneumoniae* changed its form?

- Avery
- Chase
- Griffith
- Watson

Scientists discovered that DNA was the source of genetic information. What was the other macromolecule scientists considered?

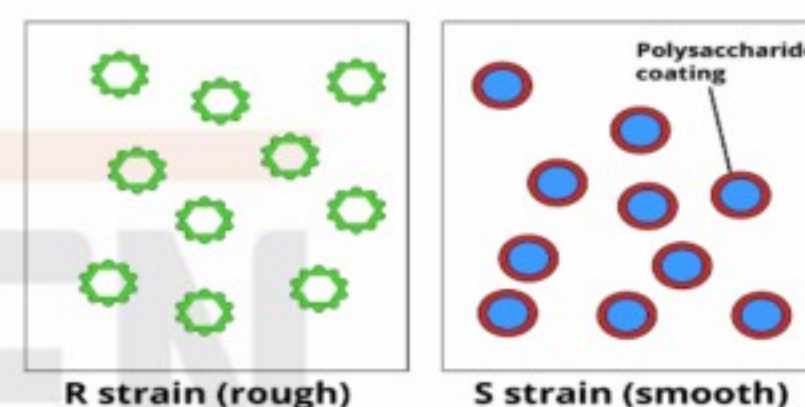
- Lipids
- Carbohydrates
- Proteins
- Water

Which was a conclusion of Griffith's work with *Streptococcus pneumoniae*?

- DNA is the genetic material in viruses.
- The structure of DNA is a double helix.
- Bacteria exposed to DNA can incorporate the DNA and change phenotype.
- The amount of thymine equals the amount of adenine in DNA.

How the presence of a sugar coat (capsule) in *Streptococcus pneumoniae* linked to a ability to cause disease?

- The sugar coat has no effect on its disease-causing ability.
- The sugar coat enhances transformation
- The sugar coat increases the bacterium's virulence
- The sugar coat reduces the bacterium's harmfulness.



What was a significant difference between Griffith's experiment and Avery's experiment?

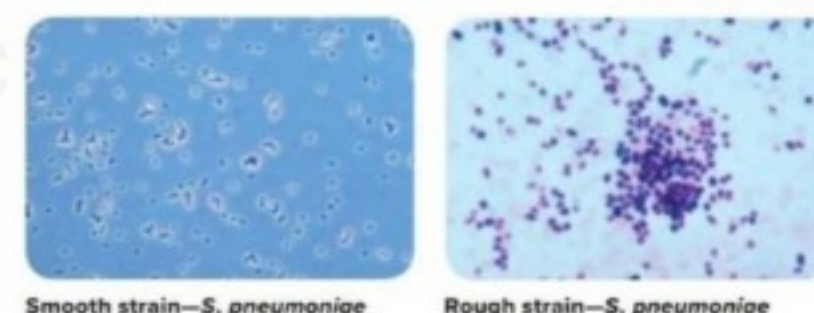
- Griffith accidentally mixed harmless R-strain with heat-killed S-strain; Avery planned to do it.
- Griffith discovered transformation; Avery discovered that DNA was the transforming factor.
- Griffith did not follow the scientific method; Avery did follow every step of the scientific method.
- Griffith was not able to reach a conclusion; Avery concluded that DNA was the genetic material

What is the process that changed rough bacteria to smooth bacteria in Griffith's experiment?

- inheritance
- injection
- conjugation
- transformation

What was the primary purpose of Frederick Griffith's 1928 experiment?

- To identify different strains of pneumonia
- To determine how to cure pneumonia
- To demonstrate that genetic material could be transferred between bacteria
- To develop a vaccine against *Streptococcus pneumoniae*



In Griffith's experiment, which of the following was NOT tested on mice?

- Live S strain bacteria
- Live R strain bacteria mixed with killed R strain bacteria
- Killed S strain bacteria
- Live R strain bacteria



What was the unexpected result in Griffith's experiment?

- a. The mouse injected with live S strain survived
- b. The mouse injected with live R strain died
- c. The mouse injected with killed S strain died
- d. The mouse injected with live R strain and killed S strain died

Based on the results of his experiment, what did Griffith conclude?

- a. S strain bacteria were resistant to heat treatment
- b. R strain bacteria could be transformed into S strain bacteria
- c. Mice were naturally immune to R strain bacteria
- d. S strain bacteria could only cause disease when alive

What was the significance of Griffith's experiment in the history of genetics?

- a. It proved that DNA was the genetic material
- b. It demonstrated that bacteria could develop resistance to antibiotics
- c. It established that bacterial traits could be inherited
- d. It set the stage for identifying the transforming substance in genetic inheritance

Who performed the first major experiment leading to the discovery of DNA as genetic material?

- a. Watson
- b. Crick
- c. Griffith
- d. Mendel

What organism did Griffith study in his experiment?

- a. E. coli
- b. Streptococcus pneumoniae
- c. Influenza virus
- d. Yeast

What was the key difference between the two bacterial strains Griffith studied?

a. One was aerobic, the other anaerobic	b. One was viral, the other bacterial
c. One had a sugar coat, the other did not	d. One was resistant to antibiotics

Which strain of S. pneumoniae caused pneumonia in mice?

- a. Rough (R) strain
- b. Smooth (S) strain
- c. Both strains
- d. Neither strain

What happened when Griffith injected mice with live R cells and killed S cells?

- a. The mouse survived
- b. The mouse developed immunity
- c. The mouse died
- d. The mouse showed no reaction

What did Griffith find in the dead mouse after injecting it with live R and killed S cells?

- a. Only dead cells
- b. Live R cells
- c. Live S cells
- d. No bacteria

What conclusion did Griffith draw from his experiment?

- a. Bacteria cannot change form
- b. DNA is not involved in heredity
- c. A transforming factor passed genetic information
- d. Only live bacteria can cause disease

What was the significance of Griffith's experiment?

- a. It proved the existence of viruses
- b. It suggested that genetic material could be transferred
- c. It identified the structure of DNA
- d. It showed that bacteria are immune to transformation

Table 1 Summary of Hershey-Chase Results

Group 1 (Viruses labeled with ^{32}P)		Group 2 (Viruses labeled with ^{35}S)	
Infected Bacteria	Liquid with Viruses	Infected Bacteria	Liquid with Viruses
- Labeled viral DNA (^{32}P) found in the bacteria - Viral replication occurred - New viruses contained ^{32}P	- No labeled DNA - No viral replication	- No labeled viral proteins (^{35}S) - Viral replication occurred - New viruses did not have a label	- Labeled proteins found - No viral replication

The Hershey-Chase experiments provided evidence that:

- In DNA the amount of cytosine = the amount of guanine and the thymine = the amount of adenine
- DNA is the genetic material of viruses
- Protein is the genetic material of bacteria
- Protein is the genetic material of viruses

Which of the following was a conclusion of Hershey and Chase's on the E.coli bacteria?

- The amount of thymine equals the amount of adenine in DNA
- DNA is the genetic material that could be passed from generation to generation
- The structure of DNA is a double helix
- Determine the basic structure of nucleotide that make up the DNA

Which scientist(s) definitively proved that DNA transfers genetic material?

- Watson and Crick
- Mendel
- Hershey and Chase
- Avery

What technique did Hershey and Chase use in their experiment that led to the conclusion that DNA, not protein, was the genetic material in viruses?

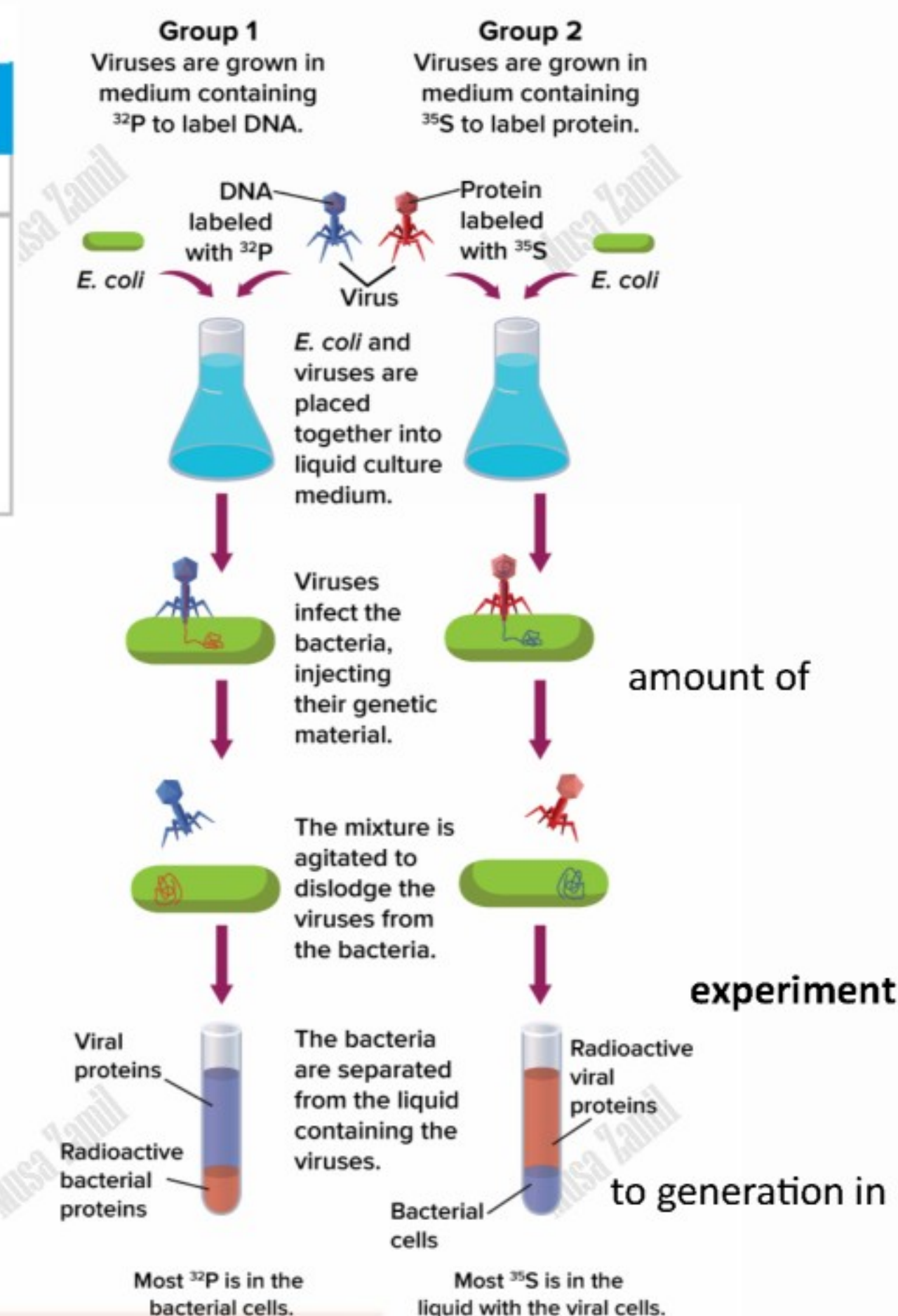
- transformation
- radioactive labeling
- X-ray diffraction
- Modeling

What did Hershey and Chase discover using radioactive labeling?

- DNA and proteins contain genetic material.
- Enzymes contain genetic material.
- DNA contains genetic material.
- Proteins contain genetic material.

What experimental technique did Hershey and Chase use to confirm that DNA was the hereditary material?

- marking viral DNA and proteins with different radioactive isotopes
- injection of viral DNA into the mouse bloodstream
- marking S strain bacteria with radioactive isotopes
- isolation of DNA from two strains of bacteria





In Hershey-Chase experiment, they labeled one set of bacteriophages with radioactive phosphorus (^{32}P) for:

- Tracking protein and DNA because both contain phosphorous.
- Tracking bacteriophage division because it contains phosphorous
- Tracking Protein because Protein contains phosphorous
- Tracking DNA because DNA contain phosphorous.

Hershey and Chase used radioactive ^{35}S and ^{32}P in experiments to provide evidence that DNA was the genetic material.

These experiments pointed to DNA because

- progeny viruses retained ^{32}P but not ^{35}S
- retention of ^{32}P in progeny viruses indicated that DNA was passed on
- loss of ^{35}S in progeny viruses indicated that proteins were not passed on
- All of the above

In Hershey Chase experiment, Protein labeling was done by _____.

- Radioactive Phosphorus ^{37}P
- Radioactive sulphur ^{34}S
- radioactive sulphur ^{35}S
- radioactive Phosphorus ^{32}P

In Hershey and Chase experiment, DNA labeling was done by _____.

- Radioactive phosphorus ^{37}P
- Radioactive sulphur ^{34}S
- Radioactive sulphur ^{35}S
- Radioactive Phosphorus ^{32}P

What was the primary purpose of the Hershey-Chase experiment?

- To prove that proteins are the genetic material
- To demonstrate that DNA is the genetic material
- To show that viruses can infect bacteria
- To develop new radioactive labeling techniques

In the experiment, why did Hershey and Chase use radioactive phosphorus (^{32}P)?

- Because both DNA and proteins contain phosphorus
- Because bacteria contain phosphorus but viruses do not
- Because DNA contains phosphorus but proteins do not
- Because phosphorus is easily detected in laboratory conditions

What happened to the radioactive sulfur (^{35}S) in the experiment?

- It was found inside the bacterial cells
- It was evenly distributed between bacteria and viruses
- It was transformed into phosphorus
- It remained outside the bacterial cells with viral proteins

What conclusion could be drawn from the observation that viruses released from infected bacteria contained ^{32}P ?

- Proteins must be the genetic material
- Both DNA and proteins are required for viral replication
- DNA is passed from the virus to new viral offspring
- Radioactive phosphorus can survive the replication process

Chargaff

Erwin Chargaff analyzed the amount of adenine, guanine, thymine, and cytosine in the DNA of various species. A portion of Chargaff's data, published in 1950, is shown in Figure 4. Chargaff found that the amount of guanine nearly equals the amount of cytosine, and the amount of adenine nearly equals the amount of thymine within a species. This finding is known as Chargaff's rule: $C = G$ and $T = A$.

Chargaff's Data				
	Base Composition (Mole Percent)			
Organism	A	T	G	C
<i>Escherichia coli</i>	26.0	23.9	24.9	25.2
Yeast	31.3	32.9	18.7	17.1
Herring	27.8	27.5	22.2	22.6
Rat	28.6	28.4	21.4	21.5
Human	30.9	29.4	19.9	19.8

Figure 4 Chargaff's data showed that though base composition varies from species to species, within a species $C = G$ and $A = T$.

Three samples of DNA contain the percentages of nitrogenous bases listed in Table. According to Chargaff's law,

	Adenine	Cytosine
Sample 1	34%	16%
Sample 2	16%	34%
Sample 3	33%	17%

- 1 and 2
- 1 and 3
- 2 and 3
- cannot tell without data on guanine and thymine

A particular sequence of parent DNA has four purine bases and two pyrimidine bases. According to base-pairing rules, which of the following sequences could be formed during replication?

- two cytosine, two adenine, two thymine
- two cytosine, two adenine, two uracil
- two adenine, two thymine, one guanine, one cytosine
- two adenine, two guanine, two cytosine

If 23% of your DNA consists of G, how much C do you have?

- 54%
- 46%
- 27%
- 23%

If 17% of DNA consists of T, how much % of G is there?

- 34%
- 66%
- 33%
- 17%

The figure below represents the structure of the DNA double strand. If a section of DNA has 30 percent Thymine, how much cytosine will it have?



- 20%
- 30%
- 40%
- 60%

According to Chargaff's rule, which of the following statements is correct?

- The amount of adenine equals the amount of guanine
- The amount of cytosine equals the amount of thymine
- The amount of guanine equals the amount of cytosine
- The total amount of purines equals the total amount of pyrimidines

Based on the data in Figure 4, which organism shows the closest adherence to Chargaff's rule for the A=T relationship?

- Escherichia coli
- Yeast
- Herring
- Rat

Chargaff's Data				
Organism	Base Composition (Mole Percent)			
	A	T	G	C
<i>Escherichia coli</i>	26.0	23.9	24.9	25.2
Yeast	31.3	32.9	18.7	17.1
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Rat	28.6	28.4	21.4	21.5
Human	30.9	29.4	19.9	19.8

What significant pattern can be observed from Chargaff's data across different species?

- All species have exactly the same base composition
- Base composition varies between species, but within a species $C \approx G$ and $A \approx T$
- Humans have the highest percentage of adenine among all species studied
- The mole percent of thymine is always higher than cytosine in all organisms

In human DNA, according to the data provided, which base has the highest mole percent?

- Adenine
- Thymine
- Guanine
- Cytosine

If you were to analyze a new species and found that its DNA contained 22% guanine, approximately what percentage of cytosine would you expect to find based on Chargaff's rule?

- 22%
- 28%
- 30%
- It cannot be determined from Chargaff's rule



27	BIO.3.3.01.012: Analyze a simulated strand of DNA to determine the genetic code and base pairing of DNA	FIGURE 5	44
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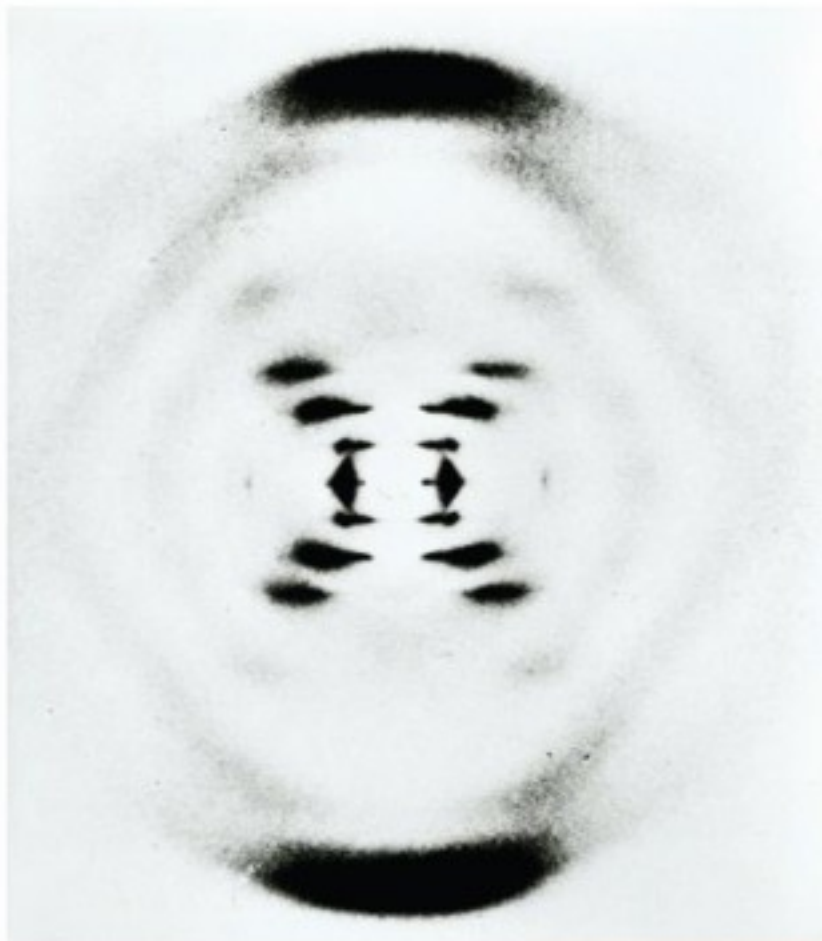


Figure 5 Rosalind Franklin's Photo 51 and X-ray diffraction data helped Watson and Crick solve the structure of DNA. When analyzed and measured carefully, the pattern shows the characteristics of a helical structure.

What technique did Rosalind Franklin use at King's College that contributed to understanding DNA structure?

- a. Electron microscopy
- b. X-ray diffraction
- c. Nuclear magnetic resonance
- d. Gel electrophoresis

What was the significance of Photo 51 in the discovery of DNA's structure?

- a. It revealed the chemical composition of nucleotides
- b. It showed that DNA contains four types of bases
- c. It indicated that DNA has a double helix structure
- d. It demonstrated how DNA replicates

Who ultimately determined the specific structure of the DNA double helix?

- a. Rosalind Franklin alone
- b. Watson and Crick using Franklin's data
- c. Wilkins independently
- d. King's College research team collectively

According to the passage, DNA can be described as:

- a. A single strand of nucleotides in a linear arrangement
- b. A twisted ladder shape formed by two complementary strands
- c. Four separate nucleotide chains bound by proteins
- d. A circular molecule found only in simple organisms

When did Rosalind Franklin join the staff at King's College?

- a. 1945
- b. 1948
- c. 1951
- d. 1953

28	BIO.3.3.01.0168 Explain the current model of DNA replication and describe the different repair mechanisms that can correct mistakes in DNA sequencing including the mechanisms of biotechnology and bioinformatics.	FIGURE 9	49
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Semiconservative Replication

When Watson and Crick presented their model of DNA to the science community, they also suggested a possible method of replication called semiconservative replication. During **semiconservative replication**, parental strands of DNA separate, serve as templates, and produce DNA molecules that have one strand of parental DNA and one strand of new DNA. Recall that DNA replication occurs during interphase of mitosis and meiosis, allowing genetic information to be transmitted during these processes. An overview of semiconservative replication is shown in Figure 9. The process of semiconservative replication occurs in three main stages: unwinding, base pairing, and joining.

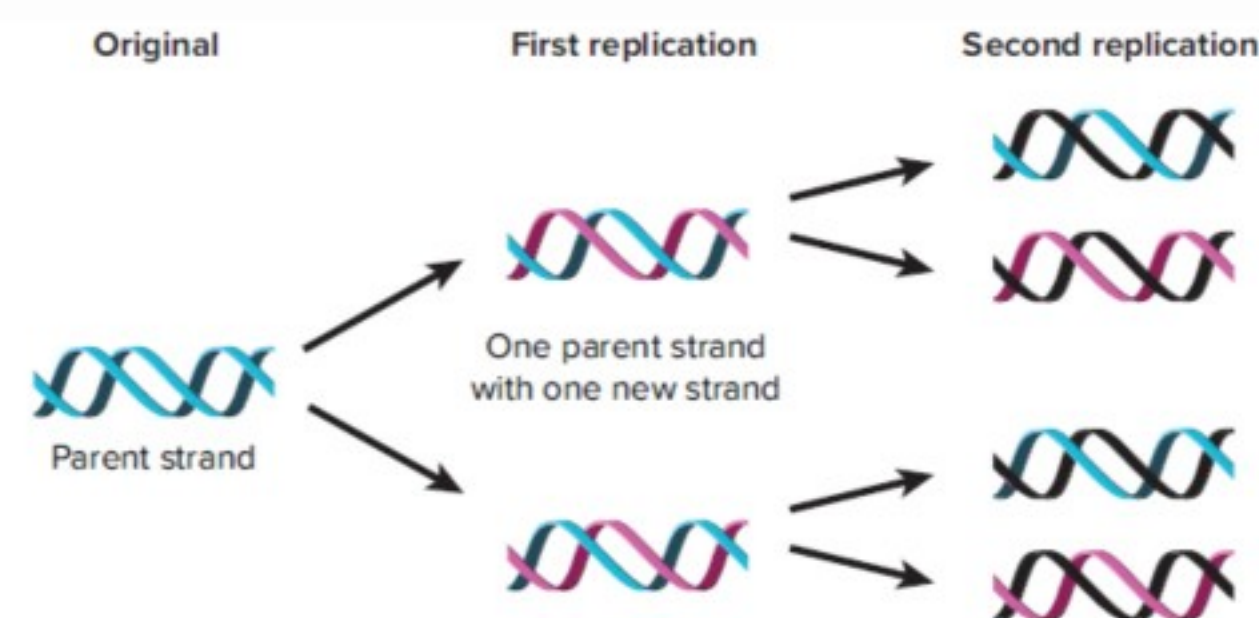


Figure 9 In semiconservative replication, the parental DNA strands separate and serve as templates to produce two daughter DNA molecules, which then can separate to produce four DNA molecules. Explain how replication ensures that DNA of successive generations of cells during mitosis is the same.

DNA replication is called "semi-conservative." Why might this be?

- a. The old strand is "conserved" and used to make the new strands
- a. Uracil is "conserved" in that it is only used to make the new strands
- b. ATP is "conserved" via the usage of facilitated diffusion
- c. Ligase is "conserved" in that it is denatured by the process

During semiconservative replication, what is the composition of the resulting DNA molecules?

- a. Two strands of new DNA
- b. Two strands of parental DNA
- c. One strand of parental DNA and one strand of new DNA
- d. Random mixtures of parental and new DNA

At which stage of the cell cycle does DNA replication occur?

- a. Prophase
- b. Interphase
- c. Telophase
- d. Cytokinesis

Which of the following best explains why semiconservative replication is important for genetic continuity?

- a. It allows for rapid mutation of DNA
- b. It ensures each daughter cell receives identical genetic information
- c. It eliminates all parental DNA in new cells
- d. It prevents DNA from being replicated

The three main stages of semiconservative replication are:

- a. Transcription, translation, and protein synthesis
- b. Unwinding, base pairing, and joining
- c. Mitosis, meiosis, and cytokinesis
- d. Replication, division, and mutation



According to the information provided, what happens to the parental DNA strands during semiconservative replication?

- a. They are destroyed
- b. They separate and serve as templates
- c. They combine with RNA
- d. They remain together as a double helix

What is the primary function of DNA helicase during DNA replication?

- a. To add RNA primers to DNA strands
- b. To break hydrogen bonds and unwind the double helix
- c. To keep the separated DNA strands apart
- d. To create new DNA strands from the template

In the semiconservative replication model shown in Figure 9, what is maintained in each new DNA molecule after the first replication?

- a. Two completely new strands of DNA
- b. Two completely original parent strands
- c. One original parent strand paired with one new strand
- d. Random fragments of both parent and new strands

Which protein binds to the separated DNA strands during replication to prevent them from rejoining?

- a. DNA helicase
- b. Single-stranded binding proteins
- c. RNA primase
- d. DNA polymerase

Based on the semiconservative replication model, after two rounds of replication, what proportion of the DNA molecules will contain one original parent strand?

- a. None of the molecules
- b. Half of the molecules
- c. All of the molecules
- d. Three-quarters of the molecules

How does the semiconservative replication process ensure DNA consistency during successive generations of mitotic cell division?

- a. By creating completely new DNA strands each generation
- b. By using the original strands as templates for new complementary strands
- c. By maintaining the exact same DNA molecules across generations
- d. By randomly mixing segments of parent and daughter DNA strands



29	BIO.3.3.01.0168 Explain the current model of DNA replication and describe the different repair mechanisms that can correct mistakes in DNA sequencing including the mechanisms of biotechnology and bioinformatics.	UNWINDING	50
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Unwinding

DNA helicase, an enzyme, unwinds and unzips the double helix. The enzyme breaks the hydrogen bonds between the base pairs and the double helix unzips leaving single strands of DNA. Then, proteins called single-stranded binding proteins associate with the DNA to keep the strands separate. As the helix unwinds, another enzyme, RNA primase, adds a short segment of RNA, called an RNA primer, on each DNA strand.

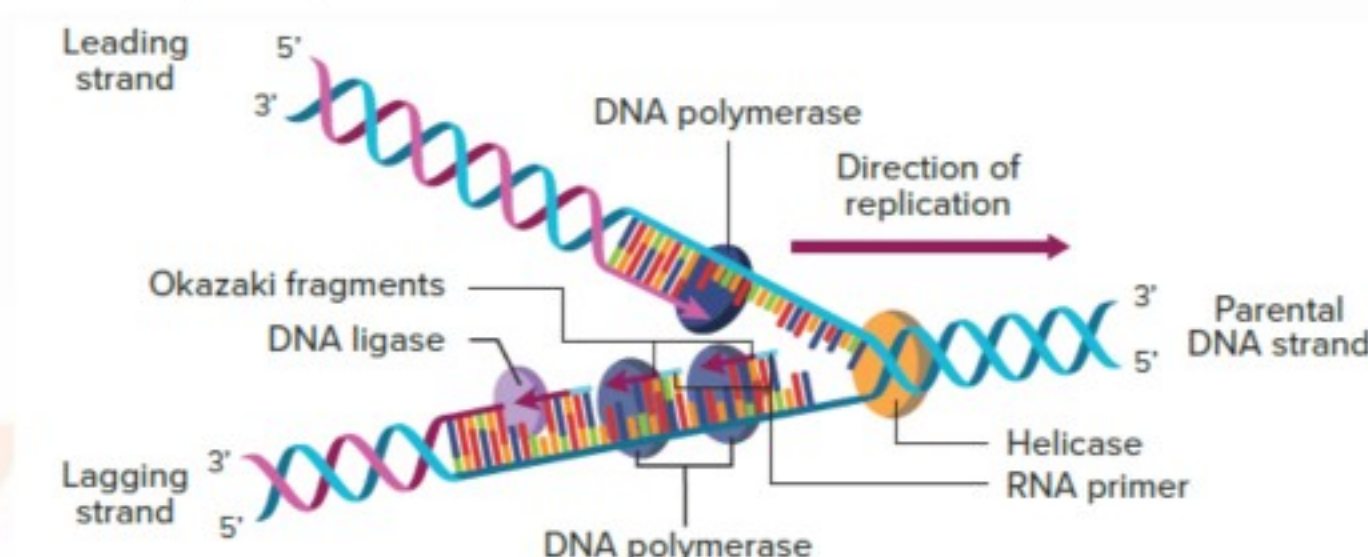
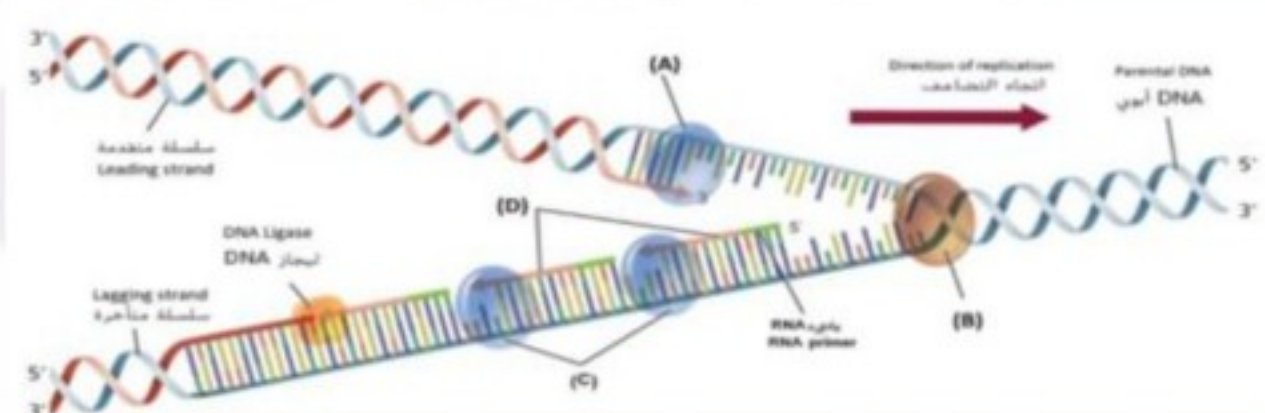


Figure 10 The DNA strands are separated during replication as each parent strand serves as a template for new strands.

What is the primary function of DNA helicase?

- To add RNA primers to DNA strands
- To break hydrogen bonds and unwind the DNA double helix
- To keep DNA strands separate after unwinding
- To replicate the DNA molecule

MOE-Q: The DNA strands are separated during replication as each parent strand serves as a template for new strands, as shown in the figure below. Which of the following represents helicase enzyme?



- B
- C
- D
- A

Single-stranded binding proteins serve what purpose in DNA unwinding?

- They create RNA primers
- They break the hydrogen bonds between base pairs
- They prevent the separated DNA strands from rejoining
- They initiate the unwinding process

Which enzyme is responsible for adding RNA primers during DNA unwinding?

- DNA helicase
- Single-stranded binding proteins
- DNA polymerase
- RNA primase

What type of bonds are broken by DNA helicase during unwinding?

- Hydrogen bonds
- Phosphodiester bonds
- Peptide bonds
- Covalent bonds



What is an RNA primer in the context of DNA unwinding?

- a. An enzyme that initiates DNA replication
- b. A protein that keeps DNA strands separate
- c. A short segment of RNA added to DNA strands
- d. The original DNA template used for replication

The synthesis of a new strand of DNA begins with which of the following?

- a. transfer RNA
- b. DNA nucleotide
- c. RNA primer
- d. messenger RNA

The next diagram displays the proteins and enzymes involved in the replication of DNA. If a defect caused the protein labeled "SSB" to fall apart, what is the most likely direct result?

- a. the DNA helix would re-coil, making transcription impossible
- b. the DNA strand would be copied twice
- c. DNA polymerase on the leading strand would combine with DNA polymerase on the lagging strand
- d. Okazaki fragments could not be connected together

MOE-Q: Which of the following is the first event of the unwinding during semiconservative replication?

- a. DNA polymerase breaks the covalent bonds forming the DNA
- b. DNA helicase separates the two DNA chains
- c. DNA helicase breaks the covalent bonds forming the nucleotides
- d. DNA polymerase catalyzes the addition of appropriate nucleotides to the DNA strand



Comparing DNA Replication in Eukaryotes and Prokaryotes

Eukaryotic DNA unwinds in multiple areas as DNA is replicated. Each individual area of a chromosome replicates as a section, which can vary in length from 10,000 to one million base pairs. Multiple replication origins look like bubbles in the DNA strand, as shown in Figure 11.

In prokaryotes, the circular DNA strand is opened at one origin of replication, as shown in Figure 11. Notice that DNA replication occurs in two directions, just as it does in eukaryotes. Prokaryotic DNA is typically shorter than eukaryotic DNA and remains in the cytoplasm, not packaged in a nucleus.

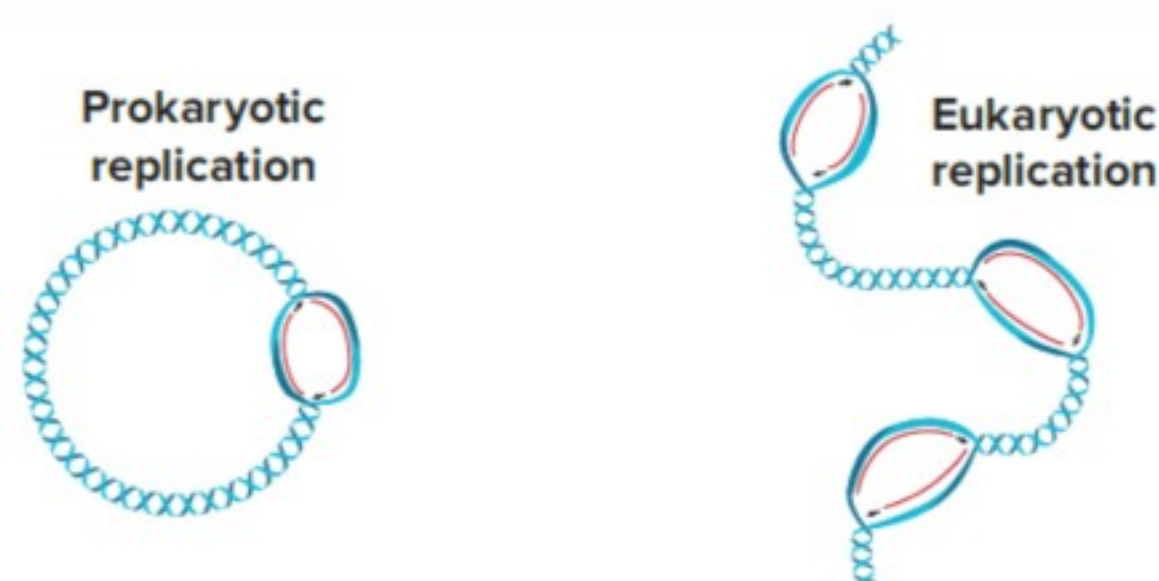


Figure 11 Eukaryotes have many origins of replication. Bacteria have one origin of replication, with the DNA replicating in both directions when it unzips.

What does this diagram show about the replication of DNA in eukaryotic cells?

- DNA is replicated only at certain places along the chromosome.
- DNA replication is both semicontinuous and conservative.
- Multiple areas of replication occur along the chromosome at the same time.
- The leading DNA strand is synthesized discontinuously.

Which of the following is a key difference between prokaryotic and eukaryotic DNA replication?

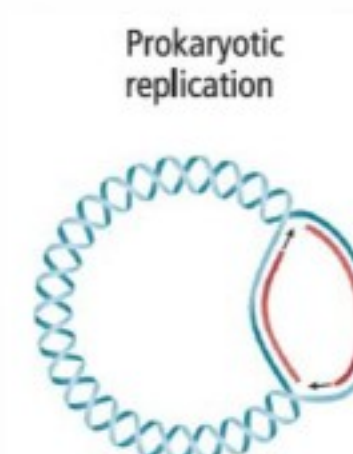
- Prokaryotic DNA is circular; eukaryotic DNA is linear.
- Eukaryotic DNA has a single origin of replication; prokaryotic DNA has multiple.
- Prokaryotic replication is slower than eukaryotic replication.
- Eukaryotic cells do not use DNA polymerase.

What is the role of the replication bubble in DNA replication?

- To synthesize RNA primers
- To provide space for DNA synthesis
- To stabilize the DNA strands
- To join Okazaki fragments

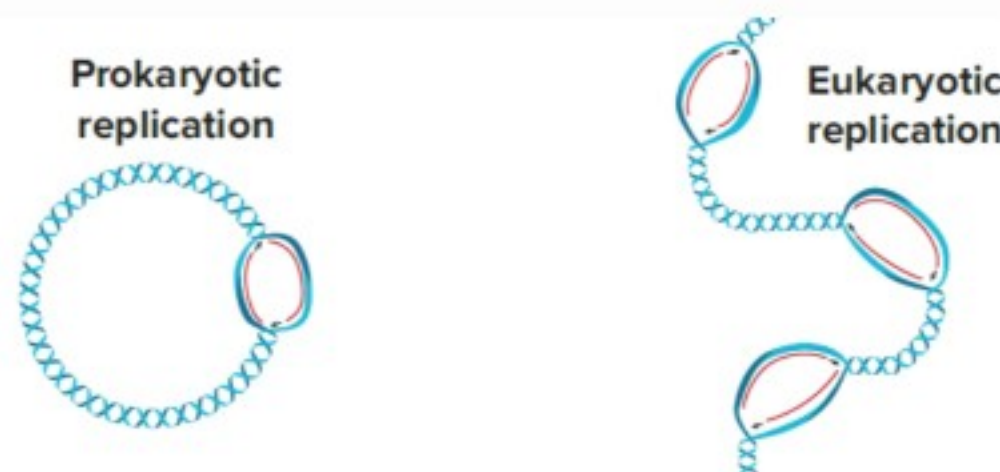
What does this diagram show about the replication of DNA in prokaryotes?

- DNA strand is opened at one origin of replication
- DNA replication occurs in one direction
- DNA is typically longer than eukaryotic DNA
- Multiple areas of replication occur along the chromosome at the same time.



What difference in eukaryotic and prokaryotic replication is shown here?

- Prokaryotes do not replicate their DNA.
- Prokaryotic replication occurs at multiple origins.
- Eukaryotic replication occurs in only one direction.
- Eukaryotic replication occurs at multiple origins



بطاقة الأحياء صف 12 متقدم شرح أ. مومس زامل



● ● ● جاهز للنجاح وإطلاق إبداعاتك ● ● ●

فيديوهات ▶ ملازم شرح ▶ أوراق عمل ▶ اختبارات

مراجعة تفصيلية شاملة للهيكل

للاشتراك في البطاقة واتساب الدعم
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