AP BIO INSTA-REVIEW

TOPIC 5.3

Mendelian Genetics

EVO-2.A.1

DNA and RNA are carriers of genetic information.

EVO-2.A.2

Ribosomes are found in all forms of life.

EVO-2.A.3

Major features of the genetic code are shared by all modern living systems.

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TOPIC 5.3

Mendelian Genetics

EVO-2.A.4

Core metabolic pathways are conserved across all currently recognized domains.

IST-1.I.1

Mendel's laws of segregation and independent assortment can be applied to genes that are on different chromosomes

RELEVANT EQUATION

Laws of Probability—

If A and B are mutually exclusive, then:

$P(A \text{ or } B) = P(A) + P(B)$

If A and B are independent, then:

$P(A \text{ and } B) = P(A) \times P(B)$

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TOPIC 5.3

Mendelian Genetics

IST-1.I.2

Fertilization involves the fusion of two haploid gametes, restoring the diploid number of chromosomes and increasing genetic variation in populations by creating new combinations of alleles in the zygote–

a. Rules of probability can be applied to analyze passage of single-gene traits from parent to offspring.

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TOPIC 5.3

Mendelian Genetics

IST-1.I.2

b. The pattern of inheritance (monohybrid, dihybrid, sex-linked, and genetically linked genes) can often be predicted from data, including pedigree, that give the parent genotype/phenotype and the offspring genotypes/phenotypes.

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TOPIC 5.3

Which macromolecule carries the genetic code?

A. Carbohydrates

B. Lipids

C. Nucleic Acids

D. Proteins

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TOPIC 5.3

Which macromolecule carries the genetic code?

C. Nucleic Acids

Nucleic acids are made up a sugar, nitrogenous base, and a phosphate group.

DNA has deoxyribose (sugar) and thymine (N base) while RNA has ribose (sugar) and uracil (N base).

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TOPIC 5.3

All cells have ribosomes...

A. True

B. False

AP BIO INSTA-REVIEW

TOPIC 5.3

All cells have ribosomes...

A. True

All cells have ribosomes. Recall, prokaryotes do NOT have membrane bound organelles, but the ribosome is not membrane bound.

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TOPIC

5.3

What is the ribosome's role in terms of gene expression?

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TOPIC 5.3

What is the ribosome's role in terms of gene expression?

The ribosome is the site of protein synthesis. This is the site where the genotype is expressed as a phenotype (the genetic information is used to create proteins)

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TOPIC 5.3

If you take one gene from one organism and insert in another organism, the organism can synthesize the same protein.

A. True

B. False

AP BIO INSTA-REVIEW

TOPIC 5.3

If you take one gene from one organism and insert in another organism, the organism can synthesize the same protein.

A. True

This demonstrates common descent. All organisms are related to a common ancestor where the genetic code emerged.

All cells have the same four nitrogenous bases and twenty or so amino acids. The genetic code is universal.

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TOPIC 5.3

Evolutionarily, why are you able to insert one gene into another & get same product?

AP BIO INSTA-REVIEW

TOPIC 5.3

Evolutionarily, why are you able to insert one gene into another & get same product?

All organisms share the same genetic code. It emerged in the common ancestor and is an ancestral trait.

AP BIO INSTA-REVIEW

TOPIC 5.3

Mendel described anaphase I as the law of ...

A. Autosomes

B. Dominance

C. Independent Assortment

D. Segregation

AP BIO INSTA-REVIEW

TOPIC 5.3

Mendel described anaphase I as the law of ...

D. Segregation

Mendel describes this as the law of segregation as the homologous chromosomes SEGREGATE to opposite pôles
(and the maternal & paternal chromosomes separate)

AP BIO INSTA-REVIEW

TOPIC 5.3

Mendel described metaphase I as the law of ...

A. Autosomes

B. Dominance

C. Independent Assortment

D. Segregation

AP BIO INSTA-REVIEW

TOPIC 5.3

Mendel described metaphase I as the law of ...

C. Independent Assortment

When the homologous chromosomes align on the metaphase plate, the two chromosomes will align independent of one another on the metaphase plate. The variance that results is called "independent assortment".

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TOPIC 5.3

What is the significance of gametes being haploid?

AP BIO INSTA-REVIEW

TOPIC 5.3

What is the significance of gametes being haploid?

When two gametes fuse (fertilization), the chromosome number is restored as diploid. If the cells were diploid, then after fertilization the zygote would be a tetraploid (too much genetic information)

AP BIO INSTA-REVIEW

TOPIC 5.3

The type of inheritance where the phenotype is intermediate

A. Codominance

B. Complete dominance

C. Incomplete dominance

AP BIO INSTA-REVIEW

TOPIC 5.3

The type of inheritance where the phenotype is intermediate

C. Incomplete dominance

Neither allele is completely dominant. This results in a blending between the two dominant alleles to result in a different phenotype.

Example: Red X White → Pink

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TOPIC
5.3

For incomplete dominance, what phenotypic ratio do you expect in monohybrid cross?

Monohybrid by definition means two parents are heterozygous.

A. 1:1:1:1
B. 1:2:1
C. 3:1
D. 4:0

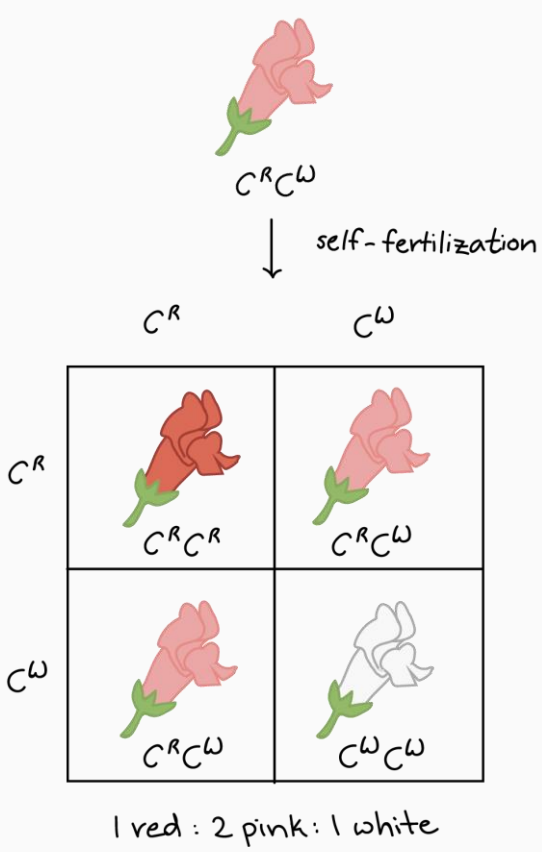
AP BIO INSTA-REVIEW

TOPIC 5.3

For incomplete dominance, what phenotypic ratio do you expect in monohybrid cross?

B. 1:2:1

As you see in the punnett square, there is 1 homozygous dominant (C^RC^R), 2 heterozgyous (C^RC^W), & 1 homozygous dominant (C^WC^W)



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TOPIC 5.3

What type of inheritance has a 3:1 ratio in monohybrid cross?

A. Codominance

B. Complete dominance

C. Incomplete dominance

D. Pleiotropy

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TOPIC 5.3

What type of inheritance has a 3:1 ratio in monohybrid cross?

B. Complete dominance

In complete dominance, the dominant will mask the recessive allele. The homozgyous dominant and heterozygous will have the same phenotype. Due to this, a monohybrid cross will result in 1 homozygous dominant (dominant phenotype), 2 heterozgyous (dominant phenotype), & 1 homozygous recessive (recessive phenotype)

AP BIO INSTA-REVIEW

TOPIC 5.3

Blood type phenotype can be A, B, AB, or O. This is an example of which type of dominance?

A. Codominance

B. Complete dominance

C. Incomplete dominance

AP BIO INSTA-REVIEW

TOPIC 5.3

Blood type phenotype can be A, B, AB, or O. This is an example of which type of dominance?

A. Codominance

Codominance results in exposure of BOTH dominant alleles at the same time. In the blood type example, the AB blood type has both the I^A and I^B allele leading to blood with both the A and B glycolipids on the membrane.

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TOPIC

5.3

What does it mean if inheritance is autosomal vs sex-linked?

AP BIO INSTA-REVIEW

TOPIC 5.3

What does it mean if inheritance is autosomal vs sex-linked?

Autosomal – the allele is on an autosome

Autosomes are the 22 chromosomes that do not determine sex assigned at birth

Sex-linked – the allele is on a sex chromosome (now called an allosome)

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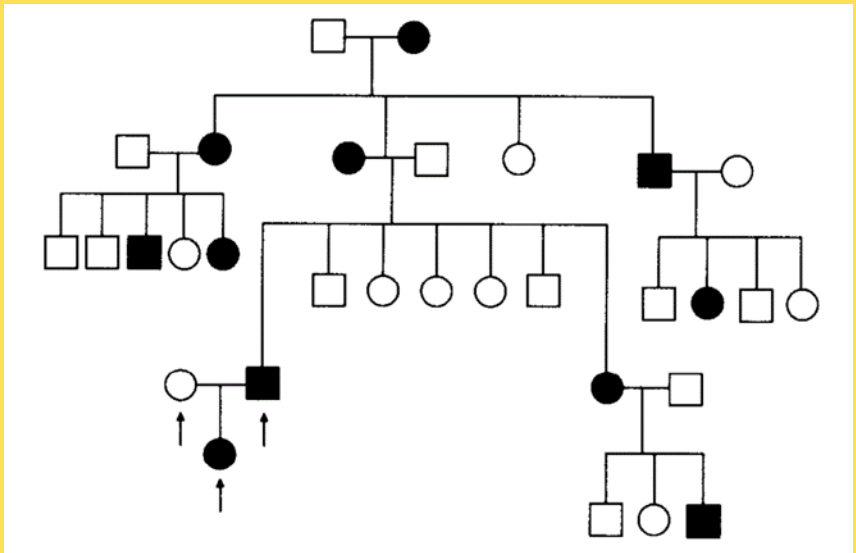
TOPIC 5.3



What type of inheritance?

A. Autosomal Dominant

B. Autosomal Recessive

C. Sex-linked Dominant

D. Sex-linked Recessive

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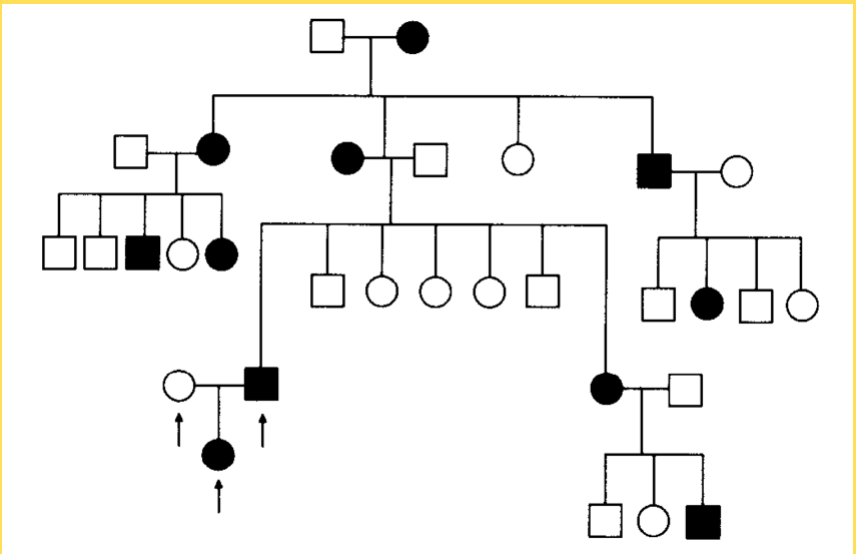
TOPIC 5.3

What type of inheritance?



A. Autosomal Dominant

When I look at pedigrees, I look whether the affected are in each generation or if it is able to skip generations. This example shows an affected individual in each generation which tells me **DOMINANT.**

Then, look for characteristics of sex-linked. In this one, you have an affected father with unaffected daughters. That is not possible since the father passing on his only X to his daughters. This tells us that it is **AUTOSOMAL.**

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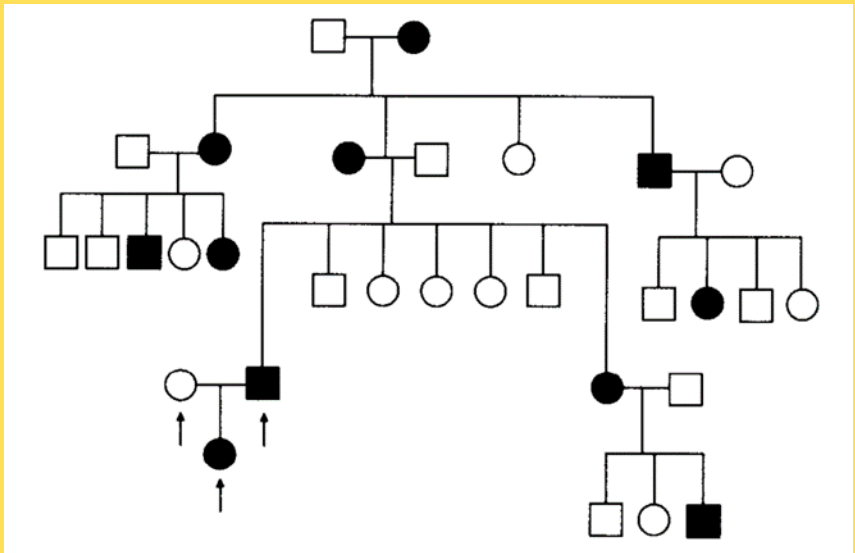
TOPIC 5.3



How do you know this is autosomal dominant?

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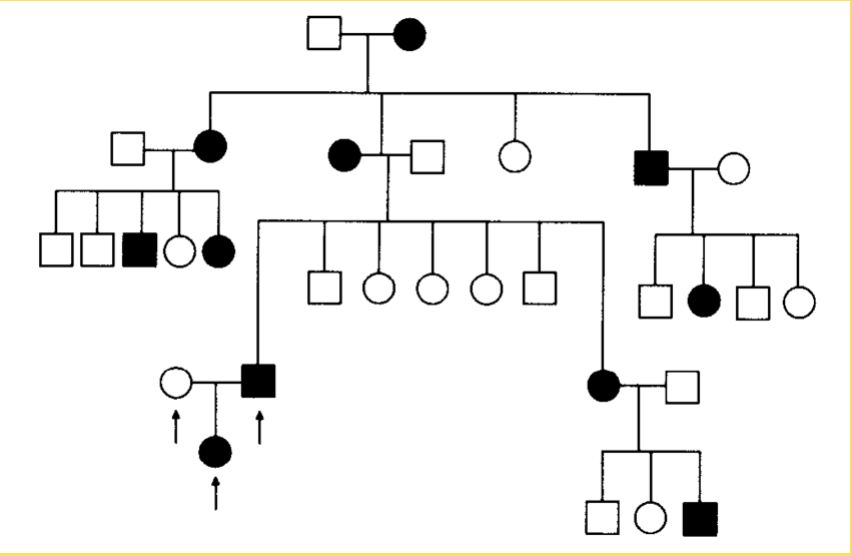
TOPIC 5.3

How do you know this is autosomal dominant?



The trait does not skip generations. It is found in every generation. Every affected individual has an affected parent. (Dominant)

If it were x linked dominant, all females of affected father would be affected. The father only has an affected X chromosome, so the daughters would HAVE to inherit it and be affected

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TOPIC 5.3

Mother has blood type O and Baby has blood type O

Which blood type could not be the father?

A. A

B. B

C. AB

D. O

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TOPIC 5.3

Mother has blood type O and Baby has blood type O

Which blood type could not be the father?

C. AB

If the mother has blood type O, then her genotype is ii. The baby that results will have blood type O, so their genotype is also ii. All of the genotypes except AB have a "i" to donate. A = I^Ai, B = I^Bi, and O = ii while AB = I^AI^B

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TOPIC

5.3

What is the phenotypic ratio of dihybrid complete dominance cross?

Dihybrid by definition is heterozygous for two alleles

A. 1:1:1:1

B. 1:2:1

C. 9:3:3:1

D. 9:6:1

AP BIO INSTA-REVIEW

TOPIC 5.3

What is the phenotypic ratio of dihybrid complete dominance cross?

Dihybrid by definition is heterozygous for two alleles

c. 9:3:3:1

- ✓ Y = dominant yellow allele
- ✓ y = recessive green allele
- ✓ R = dominant round allele
- ✓ r = recessive shriveled allele

YyRr X YyRr

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

9 : 3 : 3 : 1

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TOPIC 5.3

What is the phenotypic ratio of dihybrid complete dominance cross?

Dihybrid by definition is heterozygous for two alleles

c. 9:3:3:1

This is easiest done with monohyrbid crosses.

Let's do a specific example:
Green (G), yellow (g), Round (R), wrinkled (r)

	G	g
G	GG	Gg
g	Gg	gg

	R	r
R	RR	Rr
r	Rr	rr

Green & Round: ¾ x ¾ = 9/16

Green & wrinkled: ¾ x ¼ = 3/16

yellow & Round: ¼ x ¾ = 3/16

yellow & wrinkled: ¼ x ¼ = 1/16

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TOPIC 5.3

Pink is incomplete dominance (heterozygous)

Axial is complete dominance

Solve for the ratio of pink and axial in a dihybrid cross.

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TOPIC 5.3

Pink is incomplete dominance (heterozygous)
Axial is complete dominance

Solve for the ratio of pink and axial in a dihybrid cross.

	C^R	C^W
C^R	C^RC^R	C^RC^W
C^W	C^RC^W	C^WC^W

	A	a
A	AA	Aa
a	Aa	aa

P(pink) x P(axial)

½ x ¾

3/8

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TOPIC 5.3

Remember:

If it's in the **SAME** Punnett square, you add...

probability of axial in a monohybrid cross is 3/4 because 1/4 AA and 2/4 Aa so P(axial) = 3/4

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TOPIC 5.3

Remember:

If independent events or different Punnett squares, you multiply...

Probability of boy = 1/2

Probability of 2 boys = 1/2 x 1/2

Probability of 2 boys = 1/4

(Note: boy assigned at birth)

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TOPIC 5.3

Recommendation:

If you have anything higher than one allele for your Punnett squares, I HIGHLY recommend that you do 2x2 squares then multiply for what you are looking for

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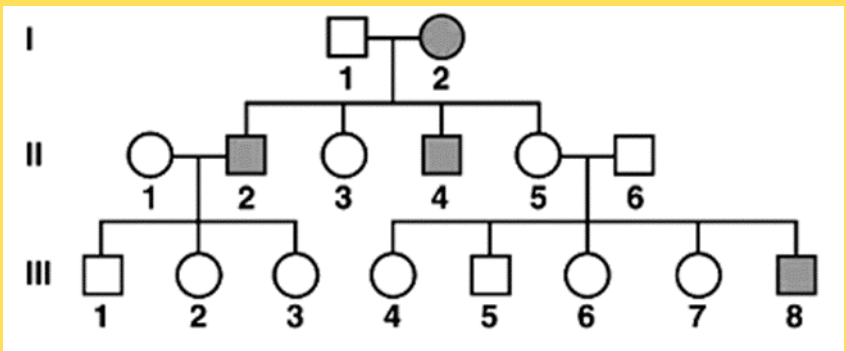
TOPIC 5.3



What type of inheritance?

A. Autosomal dominant

B. Autosomal recessive

C. Sex-Linked dominant

D. Sex-Linked recessive

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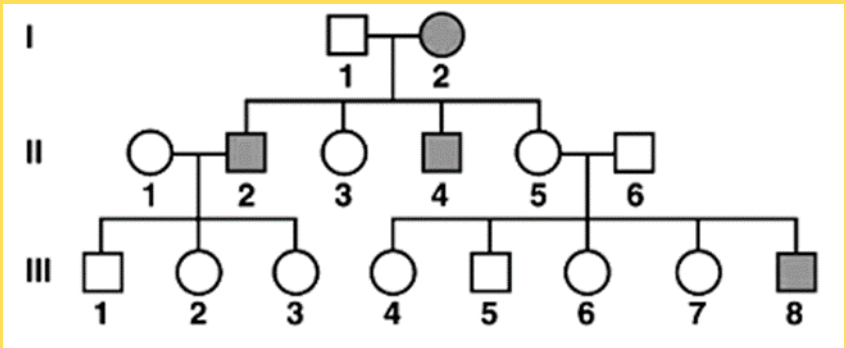
TOPIC 5.3

What type of inheritance?



D. Sex-Linked recessive

Look for whether the trait is found in every generation or skips generations, notice II-5 & II-6 are unaffected, but have an affected offspring. RECESSIVE

Look for sex-linked: You see an affected mother and ALL affected sons. SEX-LINKED

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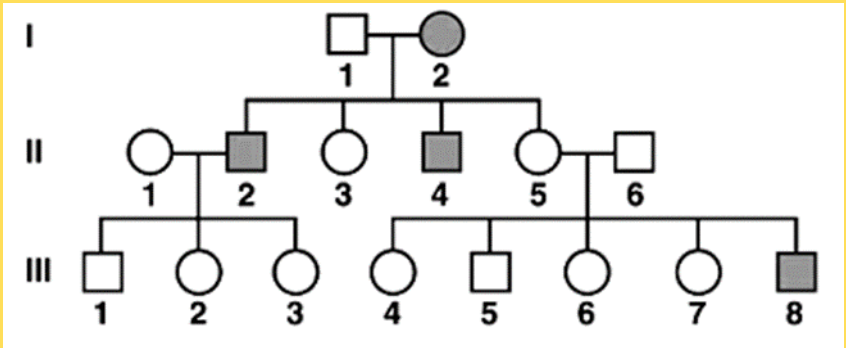
TOPIC

5.3



How do you know this is sex-linked recessive?

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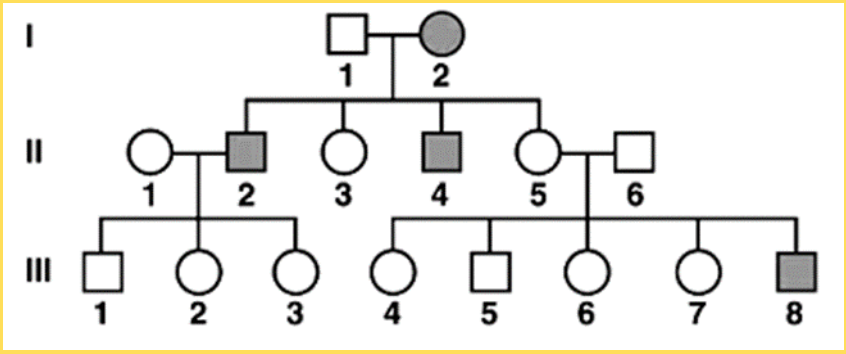
TOPIC 5.3

How do you know this is sex-linked recessive?



The trait skips the second generation (on the right). II-5 & II-6 are unaffected and then III-8 is affected (recessive)

Affected mother has affected songs (I-2, II-2, & II-4) sex-linked

Note: female/male assigned at birth

AP BIO INSTA-REVIEW

TOPIC 5.3

Which organisms have ribosomes?

A. Eukaryotes

B. Prokaryotes

C. Both

AP BIO INSTA-REVIEW

TOPIC 5.3

Which organisms have ribosomes?

C. Both

All organisms have ribosomes. This is an ancestral trait. It emerged in the common ancestor so the common ancestor to all of life had ribosomes.

AP BIO INSTA-REVIEW

TOPIC 5.3

You are able to insert genes between different organisms.

A. True

B. False

AP BIO INSTA-REVIEW

TOPIC 5.3

You are able to insert genes between different organisms.

A. True

The genetic code is universal. All organisms have the same four nitrogenous bases and twenty (or so) amino acids. The genetic code will code for the same amino acids to form the same protein in all organisms.

AP BIO INSTA-REVIEW

TOPIC 5.3

Which metabolic process do all organisms undergo?

A. Glycolysis

B. Krebs cycle

C. Oxidative phosphorylation

D. Photosynthesis

AP BIO INSTA-REVIEW

TOPIC 5.3

Which metabolic process do all organisms undergo?

A. Glycolysis

Glycolysis takes place in the cytosol. All organisms have a cytosol. This is another ancestral trait that emerged in the common ancestor to metabolize.

AP BIO INSTA-REVIEW

TOPIC 5.3

Which phase of meiosis represents the law of independent assortment?

A. Prophase I

B. Metaphase I

C. Anaphase I

D. Telophase I

AP BIO INSTA-REVIEW

TOPIC 5.3

Which phase of meiosis represents the law of independent assortment?

B. Metaphase I

The law of independent assortment refers to the homologous chromosomes aligning on the metaphase plate. Recall, the homologous chromosomes are only found during meiosis I, so this is metaphase I.

AP BIO INSTA-REVIEW

TOPIC 5.3

Which phase of meiosis represents law of segregation?

A. Prophase I

B. Metaphase I

C. Anaphase I

D. Telophase I

AP BIO INSTA-REVIEW

TOPIC 5.3

Which phase of meiosis represents law of segregation?

C. Anaphase I

The law of segregation refers to the homologous chromosomes segregating and moving apart to opposite poles. Recall, the homologous chromosomes are only found during meiosis I, so this is anaphase I.

AP BIO INSTA-REVIEW

TOPIC

5.3

What is a monohybrid or dihybrid cross?

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TOPIC 5.3

What is a monohybrid or dihybrid cross?

A cross between two individuals that are heterozygous for the trait

Monohybrid –
heterozygous is ONE allele

Dihybrid –
heterozygous for TWO alleles

AP BIO INSTA-REVIEW

TOPIC

5.3

Assuming complete dominance, what are the parents if the offspring have a 1:1 ratio?

A. Homozygous recessive and heterozygous

B. Homozygous recessive and homozygous dominant

C. Heterozygous and homozygous dominant

D. Heterozygous and heterozygous

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TOPIC 5.3

Assuming complete dominance, what are the parents if the offspring have a 1:1 ratio?

A. Homozygous recessive and heterozygous

The homozygous recessive parent is only able to donate a recessive allele. This means that the half and half must result in another parent having one dominant and one recessive allele (heterozygous).

AP BIO INSTA-REVIEW

TOPIC 5.3

What is the probability of AABBCC in a trihybrid cross?

A. 1/4
B. 1/16
C. 1/64
D. 1/256

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TOPIC 5.3

What is the probability of AABBCC in a trihybrid cross?

c. 1/64

The P(AA) from Aa x Aa = ¼, the P(BB) from Bb x Bb = ¼, and the P(CC) from Cc x Cc = ¼. So, ¼ x ¼ x ¼ = 1/64

AP BIO INSTA-REVIEW

TOPIC 5.3

How does the phenotypic ratio differ between complete or incomplete dominance?

AP BIO INSTA-REVIEW

TOPIC 5.3

How does the phenotypic ratio differ between complete or incomplete dominance?

Complete dominance: homozygous dominant and heterozygous both show the dominant phenotype (3:1)

Incomplete dominance: heterozygous is a blend between two dominant traits example: red x white pink (1:2:1)

Codominance: heterozygous shows dominant traits independently together (3:1)