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TOPIC 5.6

Chromosomal Inheritance

SYI-3.C.1

Segregation, independent assortment of chromosomes, and fertilization result in genetic variation in populations.

SYI-3.C.2

The chromosomal basis of inheritance provides an understanding of the pattern of transmission of genes from parent to offspring.

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Chromosomal Inheritance

SYI-3.C.3

Certain human genetic disorders can be attributed to the inheritance of a single affected or mutated allele or specific chromosomal changes, such as nondisjunction.

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Which of these does not cause genetic variation?

A. Fertilization
B. Independent Assortment
C. Mitosis
D. Segregation

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Which of these does not cause genetic variation?

C. Mitosis

Genetic variation involves NEW combinations. Fertilization brings two individuals together in one cell which is a new combination. Independent Assortment involves the homologous pairs independently lining up on the metaphase plate leads to unique gametes which is a new combination. Segregation involves the homologous chromosomes separating to opposite poles which is a new combination.

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How does independent assortment cause genetic variation?

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How does independent assortment cause genetic variation?

The homologous chromosomes align on the metaphase plate during metaphase I of meiosis I. These chromosomes align independent of each other. So, there's a 50% chance which pole the chromosomes will "face". If we are talking about 3 chromosomes, there's 8 different combinations that could result. If there's 4 chromosomes, there's 16 different combinations. If there's 5 chromosomes, there's 32 different combinations.

I hope you see where we are going with this.

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How does segregation cause genetic variation?

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How does segregation cause genetic variation?

After alignment during anaphase I, the homologous chromosomes will separate (segregate) to the two poles. This allows half of the genetic information to go to one cell while the other half goes to the second cell. The two cells are not the same because they each received a different chromosome from the homologous

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How does fertilization increase genetic variation?

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How does fertilization increase genetic variation?

The unique cells formed due to independent assortment, segregation, and crossing over are fused leads to new combinations of alleles.

Note: sexual reproduction is describing the sperm/egg fusion. This can occur within a **SINGLE** organism like a flower that has both pollen (sperm) and ovary (egg)

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Which phase of meiosis involved independent assortment?

A. Anaphase I

B. Metaphase I

C. Prophase I

D. Telophase I

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Which phase of meiosis involved independent assortment?

B. Metaphase I

Independent assortment involves the homologous pairs independently lining up on the metaphase plate during meiosis I. This leads to genetic diversity as the maternal and paternal of each chromosome will segregate into different cells leading to 2^{23} different outcomes.

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Which phase of meiosis involved crossing over?

A. Anaphase I

B. Metaphase I

C. Prophase I

D. Telophase I

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Which phase of meiosis involved crossing over?

C. Prophase I

Crossing over takes place when the homologous chromosomes pair up forming the tetrad. The nonsister chromatids will exchange genetic information leading to genetic variation as recombinant chromosomes are formed.

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Which phase of meiosis involved segregation?

A. Anaphase I
B. Metaphase I
C. Prophase I
D. Telophase I

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Which phase of meiosis involved segregation?

A. Anaphase I

The homologous chromosomes are lined up during metaphase, but they are separated (law of segregation) during anaphase I. This is what leads to different chromosomes being in different cells.

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There were two different theories about how traits were passed down from one generation to the next. How are traits inherited?

A. Blended Theory

B. Chromosomal Theory

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There were two different theories about how traits were passed down from one generation to the next. How are traits inherited?

B. Chromosomal Theory

The chromosomal theory states that there is a discrete particle being passed down from parents to offspring. The blending theory makes me think of incomplete dominance. Overtime, the individuals would all look the same as their traits kept blending.

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What is nondisjunction?

A. When genes move from one chromosome to another

B. When two sister chromatids are bound during prophase

C. When two cells do not undergo cytokinesis

D. When two chromosomes do not separate in anaphase

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What is nondisjunction?

D. When two chromosomes do not separate in anaphase

Nondisjunction results in the sister chromatids or homologous chromosomes not separating during anaphase. This leads to daughter cells with additional or missing chromosomes.

Example: Trisomy 21

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Nondisjunction causes extra chromosomes to be inherited. On March 21, we celebrate National Downs Syndrome Awareness Day and Downs is caused by nondisjunction. But do you know which chromosome is involved?

A. Chromosome 8

B. Chromosome 15

C. Chromosome 18

D. Chromosome 21

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Nondisjunction causes extra chromosomes to be inherited. On March 21, we celebrate National Downs Syndrome Awareness Day and Downs is caused by nondisjunction. But do you know which chromosome is involved?

D. Chromosome 21

Down syndrome involves an individual with an additional chromosome 21. This results from nondisjunction so the individual inherited an extra chromosome 21.

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Why doesn't the law of segregation apply to meiosis II?

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Why doesn't the law of segregation apply to meiosis II?

The chromosomes in meiosis are sister chromatids. They are "identical" so they will not demonstrate law of segregation.

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What is the inheritance of the sickle cell gene?

A. Autosomal dominant
B. Autosomal recessive
C. Sex-linked dominant
D. Sex-linked recessive

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What is the inheritance of the sickle cell gene?

B. Autosomal recessive

Sickle cell is an autosomal recessive trait. No, this is not required to know but it is a common example so your background knowledge could assist you to better answer the questions. You should understand that this can be observed in a pedigree by skipping generations and eqaul likihood with males and females.

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What is the mode of inheritance of hemophilia?

A. Autosomal dominant

B. Autosomal recessive

C. Sex-linked dominant

D. Sex-linked recessive

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What is the mode of inheritance of hemophilia?

D. Sex-linked recessive

Hemophilia is a sex-linked recessive trait. No, this is not required to know but it is a common example so your background knowledge could assist you to better answer the questions. You should understand that this can be observed in a pedigree by skipping generations and males being more likely to be affected than females.

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What is the mode of inheritance of polydactyl?

A. Autosomal dominant
B. Autosomal recessive
C. Sex-linked dominant
D. Sex-linked recessive

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What is the mode of inheritance of polydactyl?

A. Autosomal dominant

Polydactyl is an autosomal dominant trait. No, this is not required to know but it is a common example so your background knowledge could assist you to better answer the questions. You should understand that this can be observed in a pedigree by an individual in each generation will be affected and male and female are equally likely.

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What is nondisjunction?

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What is nondisjunction?

Chromosomes will be unable to separate during meiosis I and II.

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Which checkpoint halts to ensure all chromosomes are attached to kinetochores?

A. G_1

B. S

C. G_2

D. M

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Which checkpoint halts to ensure all chromosomes are attached to kinetochores?

D. M

The M checkpoint involves determining that every chromosome is attached to a kinetochore. If the chromosomes are not bound to the microtubules, then there will be an unequal separation of the genetic information.