

Cell biology



**ASSIGN
BUSTER**

A diploid sexually reproducing organism contains five pairs of chromosomes that do not undergo homologous recombination during meiosis. If the chromosomes are distributed independently during meiosis, how many different types of sperm or egg cells can a single individual of this species produce?

There are five different types of eggs or sperms.

2 Indicate whether the following are involved in meiosis, mitosis, both, or neither.

A. DNA replication ___ both in mitosis & meiosis _____

B. Spindle formation ___ both _____

C. Bivalent ___ in meiosis _____

D. Chromosome condensation ___ both _____

E. Maternal chromosome segregation to one cell ___ neither in mitosis nor meiosis _____

F. Genetically identical products ___ in mitosis _____

3 Cystic fibrosis is due to mutations in a single gene that lies on chromosome

7. Only homozygous mutant (ff) individuals are sick; homozygous wild-type (FF) and heterozygous (Ff) individuals are healthy. A healthy married couple has one child with cystic fibrosis and the wife is pregnant with a second child.

A. What is the genotype of the mother? The father?

Father Ff, Mother Ff.

B. What is the chance that the second child will have cystic fibrosis?

Chance of having second child affected 25%, (1/4).

4 Shown is a genetic pedigree of a family with several members affected by a heritable disease. Affected individuals are shown in black and healthy

individuals are shown in white. Males are shown as boxes and females as circles.

A. Can a single mutation explain the pattern of inheritance?

Yes

B. Is the mutation responsible for the disease dominant or recessive?

Recessive

C. Is the mutation carried more likely on the X chromosome, the Y chromosome, or an autosome?

X- linked

5 Conditional alleles are mutant gene versions that encode proteins that can function normally at the permissive condition but are defective at the restrictive condition; one commonly used condition is temperature.

Conditional alleles are especially useful to geneticists because they permit the study of essential genes. At the permissive temperature, the organism lives normally. When the organism is shifted to the non-permissive temperature, the effect of inactivating the gene can be studied. Which of the three types of mutations shown is most likely to lead to a conditional allele?

Single nucleotide substitution.

6 You are studying a diploid yeast strain that normally utilizes glucose as an energy source but can use maltose when no glucose is present. You are interested in understanding how this yeast strain utilizes maltose as an alternative energy source. To begin to understand maltose metabolism, you undertake a genetic screen to isolate genes involved in maltose metabolism by screening for yeast that cannot grow when maltose is the sole energy source. You isolate 6 different mutants, all of which are recessive, and name these alleles mal1, mal2, mal3, mal4, mal5, and mal6. Next, you isolate

gametes from the homozygous diploid mutant yeast strains and perform crosses between the different strains to do complementation analysis, because you wish to determine whether the mutations are likely to affect the same or different genes. Your results are shown in the table below:

Complementation analysis of mal genes.

mutation

mal1

mal2

mal3

mal4

mal5

mal6

mal1

-

+

+

-

+

-

mal2

+

-

+

+

-

+

mal3

+

+

-

+

+

+

mal4

-

+

+

-

+

-

mal5

+

-

+

+

-

+

mal6

-

+

+

-

+

-

“+” = growth on maltose-containing media; “-” = no growth on maltose-containing media.

In how many genes are you likely to have isolated mutations? Which alleles appear to affect the same genes? Explain your answer.

All six genes are likely to have isolated mutations.

7You are trying to map a human gene thought to be involved in cat allergies.

Because you know this gene is on chromosome 20, you decide to examine the linkage of several SNPs located on chromosome 20 with respect to the gene involved in cat allergies. You have obtained DNA from 10 individuals and know whether they are allergic to cats. Your SNP results are shown.

SNP tests for chromosome 20. (+ = presence of SNP)

allergic to

cats?

SNP1

SNP2

SNP3

SNP4

SNP5

yes

+

+

-

-

+

no

+

-

-

+

-

no

-

-

-

+

-

yes

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-

+

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yes

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yes

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yes

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+

+

no

-

-

+

-

-

A. Which SNP is most likely to be tightly linked to the gene involved in cat allergies? Explain your answer.

SNP5 is found to be mostly linked to allergies to cats.

From the chart given its clear that SNP5 is found in all patients who are allergic to cats.

B. Of the SNPs tested above, which is likely to be the next closest to the gene responsible for the allergic state? Why?

SNP2 is found to be next closest to the gene responsible for allergic state.

Because its found in all cat allergic persons except a person.