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Topic: Punnett Square Worksheet - Human Genetic Disorders

Summary: Students will learn about genetic disorders by completing Punnett squares for autosomal, sex-linked, pleiotropy, and incomplete dominant traits.

Goals & Objectives: Students will be able to determine the probability of different genetic disorders. Students will be able to recognize the differences between inheritance patterns.

NGSS Standards: *HS-LS3-3.* Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Time Length: 20 minutes

Prerequisite Knowledge: Students know how to complete a Punnett square for dominant and recessive traits. Students know vocabulary words like homozygous, heterozygous, dominant, recessive, genotype, and phenotype. Students know how to calculate ratios.

Materials:
Calculators
Class notes or textbook or online textbook:

- https://flexbooks.ck12.org/cbook/ck-12-biology-flexbook-2.0/section/3.11/primary/lesson/mendelian-inheritance-in-humans-bio/
- https://flexbooks.ck12.org/cbook/ck-12-biology-flexbook-2.0/section/3.6/primary/lesson/punnett-squares-bio/

Procedures:
1. Students work on the handout by themselves.

Accommodations: Students with an IEP can take the handout home if they need extra time, and/or do the even-numbered questions.

Editable DOCX File and Answer Key:

Available at www.ngsslifescience.com

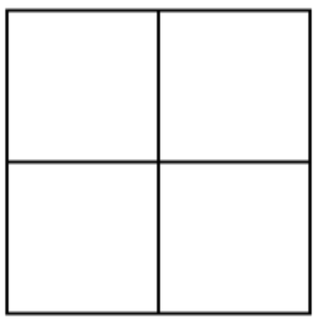
Name: _____ Row: _____

Date:_____ Period:_____

Punnett Square Worksheet - Human Genetic Disorders

Background Information: Autosomal traits are carried on chromosomes 1-22 in humans. This means the trait will appear in both sexes equally. Sex-linked traits have recessive alleles on the X chromosome. Because males only have one X chromosome, if they have the recessive allele, they will have the condition. Two types of different alleles are incomplete dominant alleles and codominant alleles. With incomplete dominance, the heterozygous genotype will express a phenotype somewhere in-between the dominant and the recessive. With codominance, the heterozygous genotype will express both phenotypes.

1) Albinism (Albino) is an autosomal recessive genetic disorder that causes deficiency of pigmentation in skin, hair, and eyes. When a single gene affects many traits, like albinism, it is called pleiotropy. Fill in the Punnett square and determine the expected genotypic and phenotypic ratios from crossing homozygous recessive and heterozygous parents.

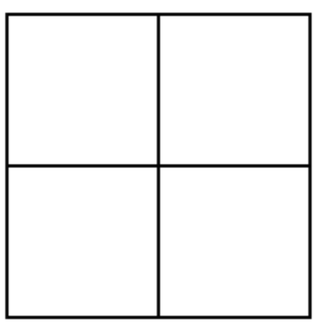


Offspring Genotypes: _____ Genotypic Ratio: _____

Circle all offspring phenotype(s): normal, carrier, has albinism

% of kids with disorder: _____ %, kids who are carriers: _____%

2) Cystic fibrosis is an autosomal recessive disease where mucus develops in the lungs, liver, and the pancreas. Fill in the Punnett square and determine the expected genotypic ratios from crossing homozygous dominant and heterozygous parents.

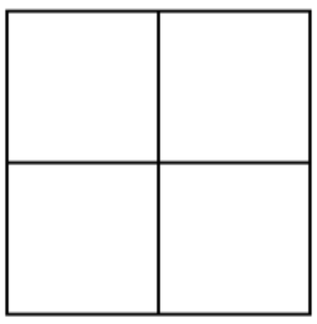


Offspring Genotypes: _____ Genotypic Ratio: _____

Circle all offspring phenotype(s): normal, carrier, has cystic fibrosis

% of kids with disorder: _____ %, kids who are carriers: _____%

3) Neurofibromatosis is a dominant autosomal genetic disorder that causes tumors to grow along types of nerves and to affect skin and bones. Fill in the Punnett square and determine the expected genotypic ratios from crossing homozygous recessive and homozygous dominant parents.

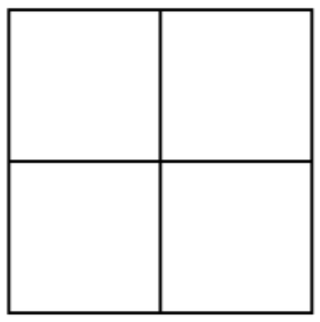


Offspring Genotypes: _____ Genotypic Ratio: _____

Circle all offspring phenotype(s): normal, has neurofibromatosis

% of kids with disorder: _____ % of normal offspring: _____%

4) Sickle-cell anemia is an autosomal recessive genetic disorder that causes red blood cells to change shape. This can cause the red blood cells to become stuck in blood vessels. This blocking can deprive tissues of oxygen and cause organ damage like strokes. One benefit of this is that people who have one or two alleles of the sickle cell disease are resistant to malaria since the red blood cells are not conducive to the parasites. Sickle-cell anemia also exhibits incomplete dominance at which the individual who does not have the disease retains immunity to malaria. Fill in the Punnett square and determine the expected genotypic ratios from crossing homozygous recessive and homozygous dominant parents.

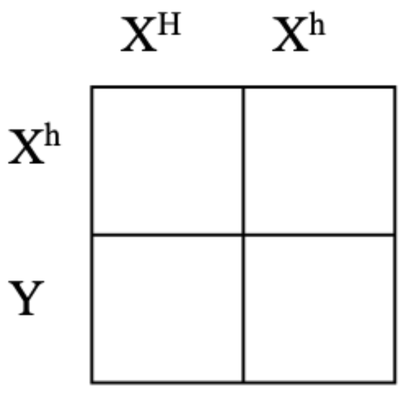


Offspring Genotypes: _____ Genotypic Ratio: _____

Circle all offspring phenotype(s): normal, carrier, has sickle-cell anemia

% of kids with disorder: _____ %, kids who are carriers: _____%

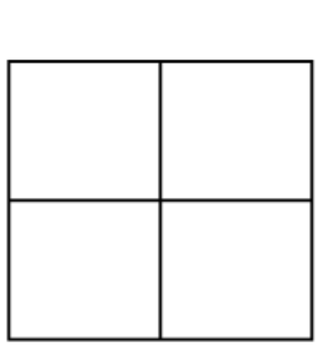
5) Hemophilia A is a recessive sex-linked genetic disorder that prevents the blood from clotting. The effects of this X chromosome disorder develop almost entirely in males even though the gene is inherited from one of the mother's X chromosome. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a male with hemophilia A and a female who is a carrier for hemophilia.



Offspring Genotypes: _____

Circle all offspring phenotype(s): normal male, male with hemophilia A, normal female, carrier female, female with hemophilia A

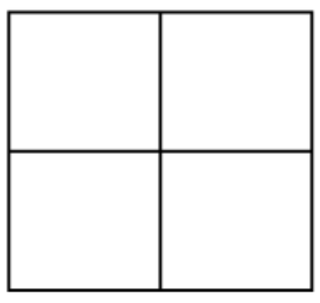
6) Red-Green colorblindness is a recessive sex-linked (X chromosome) genetic disorder where the middle (green) or long (red-yellow) wavelength cones in the eyes have a partial or complete loss of function. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a normal male and a female who is a carrier of color-blindness.



Genotypes: _____

Circle all offspring phenotype(s): normal male, male with colorblindness, normal female, carrier female, female with colorblindness

7) PKU is a recessive autosomal genetic disorder that increases the amount of a type of amino acid in the blood. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a heterozygous and a heterozygous.



Offspring Genotypes: _____ Genotypic Ratio: _____

Circle all offspring phenotype(s): normal, carrier, has PKU

% of kids with disorder: _____ %, kids who are carriers: _____%