

Genetics Practice Problems

On the following pages are several problems. With each new type of problem, we will complete the first one together. Use this as a sample to look back on while working on your homework problems.

Monohybrid Cross

- When we study the inheritance of a single gene it is called a monohybrid cross.
- A heterozygous, smooth (S) pea pod, plant is crossed with a wrinkled (s) pea pod plant. Predict the offspring from this cross.
 - What is the genotype of the parents?
 - Set up a Punnett square with possible gametes.

- Fill in the Punnett square for the resultant offspring.
 - What is the predicted genotypic ratio for the offspring?
 - What is the predicted phenotypic ration for the offspring?
 - If this cross produced 50 seeds how many would you predict to have a wrinkled pod?
- In humans, acondroplasia "dwarfism" (D) is dominant over normal (d). A homozygous dominant (DD) person dies before the age of one. A heterozygous (Dd) person is dwarfed. A homozygous recessive (dd) individual is normal. A heterozygous dwarf man marries a heterozygous dwarf woman....

- What is the probability of having a normal child?
 - What is the probability that the next child will also be normal?
 - What is the probability of having a child is a dwarf?
 - What is the probability of having a child that dies at one from this disorder?
- In humans, free earlobes (F) is dominant over attached earlobes (f). If one parent is homozygous dominant for free earlobes, while the other has attached earlobes can they produce a child with attached earlobes?

Dihybrid Cross

- When we study two traits on different chromosomes, at one time, we call this a dihybrid cross. You still follow the same process for monohybrid crosses, but now there will be four times as many possibilities because we are studying two traits.

- 4) A female guinea pig that is heterozygous for both fur color and coat texture is crossed with a male that has light fur color and is heterozygous for coat texture. What possible offspring can they produce? Dark fur is dominant (D) and light fur (d) is recessive. Rough coat texture (R) is dominant, while smooth coat (r) is recessive.

- 5) In pea plants, the round (R) seed allele is dominant over the wrinkled (r) seed allele, and the yellow (Y) seed allele is dominant over the green (y) seed allele. A plant is heterozygous for seed texture and seed color is crossed with a plant that is wrinkled and heterozygous for seed color.
- Construct a Punnett square for this cross.

- What is the expected phenotypic ratio for the offspring?

- 6) In humans there is a disease called Phenylketonuria (PKU) which is caused by a recessive allele. People with this allele have a defective enzyme and cannot break down the amino acid phenylalanine. This disease can result in mental retardation or death. Let "E" represent the normal enzyme. Also in humans a conditions called galactose intolerance or galactosemia, which is also caused by a recessive allele. Let "G" represent the normal allele for galatose digestion. In both diseases, normal dominates over recessive. If two adults were heterozygous for both traits (EeGg), what are the chances of having a child that is completely normal? Has just PKU? Has just galactosemia? Has both diseases?

Incomplete Dominance

- One allele is not completely dominant over the other. This creates a blending effect.

- 7) In purple people eaters, 2 horns are dominant (P) and no horns is recessive (p). If a purple people eater is a heterozygote, then it has 1 horn. Two heterozygous purple people eaters are about to have a baby. What are the genotypes and phenotypes that their baby could possess?

- 8) The flowers of snapdragons are dominant in red (R) and recessive in white (r). A pure red snapdragon is crossed with a pure white snapdragon. What are the genotypes and phenotypes of this cross?

- 9) A homozygous recessive female is bred to a heterozygous male. Color is incomplete dominance in these gerbils. D = dark brown, d = white. What would the results of the cross be?

Codominance

- Both alleles contribute to the phenotype equally.
- 10) In cows, fur color is codominant. Red fur color ($C^R C^R$). Roan fur color ($C^R C^W$). White fur color ($C^W C^W$). A heterozygous female is crossed with a male that is homozygous white. What is the genotypic ratio and phenotypic ratio for this cross?

- 11) Using the cow fur color again complete this different cross. The homozygous red female is crossed with a heterozygous male. What is the genotypic ratio and phenotypic ratio for this cross?

- 12) In humans, straight hair ($H^S H^S$) and curly hair ($H^C H^C$) are codominant traits, that results in wavy hair ($H^S H^C$) Cross a curly hair female with a wavy haired male.
- Complete a Punnett square for this cross.
 - What are the chances of having a curly haired child?

Multiple Allele

- Some traits are coded for by more than two alleles.
- 13) In humans there are four types of blood: Type A, Type B, Type AB, and Type O. The alleles A and B are codominant to each other and the O is recessive to both A and B alleles. So a person with genotype AA or AO will have A type of blood.
- What possible genotypes will produce B type of blood?
 - What is the only possible genotype that will produce O type of blood?
 - What is the only possible genotype that will produce AB type of blood?
 - You are blood type O and you marry a person with blood type AB.
 - Complete a Punnett square for this cross.

- List the possible blood types (phenotypes) of your offspring.
- 14) In the 1950s, a young woman sued film star/director Charlie Chaplin for parental support of her illegitimate child. Charlie Chaplin's blood type was already on record as type AB. The mother of the child is type A and her partner had type O blood.
- Complete a Punnett square for the possible cross of Charlie and the mother.

- The judge ruled in favor of the mother and ordered Charlie Chaplin to pay child support or the costs of the child. Was the judge correct in his decision based on blood typing evidence?
 - Explain your answer.
- 15) Suppose a newborn baby was accidentally mixed up in the hospital. In an effort to determine the parents of the baby, the blood types of the baby and two sets of parents were determined.
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|-------------------|-----------------------|-----------------------|
| Baby 1 had type O | Mrs. Brown had type B | Mr. Brown had type AB |
| | Mrs. Smith had type B | Mr. Smith had type B |
- Complete a Punnett square for each couple (you may need to do more than 1 square/couple)

- To which parents does baby #1 belong? Why?