

AP Biology Genetics Worksheet

Monohybrid Cross Questions

1. White colouring in guinea pigs is recessive. What will the offspring be from a cross between a white guinea pig and a heterozygous black guinea pig?
2. Free ear lobes are dominant over attached ear lobes. What will the F1 offspring be from a cross between two heterozygous free ear lobed parents?
3. The ability to taste phenylthiocarbamide (PTC) is dependent upon a dominant gene, T. The recessive allele, t, is associated with the inability to taste the substance.
 - (a) What are the possible genotypes for tasters? For non-tasters?
 - (b) Two parents, both tasters, have a non-taster offspring. What are the genotypes of the two parents? Explain.
 - (c) Two parents, one a taster and the other a non-taster, have a taster offspring. What is the genotype of the offspring? Explain.
4. In *Drosophila* (fruit flies), curled wings is recessive to its normal allele for straight wings. A homozygous curled wing male is mated with a homozygous straight winged female. What would be the genotype and phenotype of the F1?
5. Hairy tongues in the alien race of Pzkrauks is a recessive trait to the normal hairless tongues. If a male who is heterozygous normal tongued has children with a homozygous normal tongued female, what would be the genotypes and phenotypes of their offspring? What percentage would be hairy tongued? What percentage would be normal tongued?

Co-dominance and Incomplete Dominance questions

1. When shorthorn red cattle are bred to shorthorn white cattle, they produce roan (red and white hairs interspersed) offspring. What type of inheritance is this?
 - (a) If two roan shorthorns are crossed, what is the probability of red, white and roan colours in their offspring?
2. In the petunia, a pure breeding red flower is crossed with a white one to produce pink offspring. What form of inheritance is this?
 - (a) Show the genotypes of the parents and the F1 generation of a cross between a red and white petunia.
 - (b) What would be the anticipated offspring if the F1 plant from (a) above were test-crossed to the red parent?
 - (c) What would be the anticipated offspring if the F1 plant from (a) above were test-crossed to the white parent?

3. In andalusian fowl, F^B is the gene for black plumage. F^b is the gene for white plumage. These genes show incomplete dominance. The heterozygous condition results in blue plumage. List the genotypic and phenotypic ratios expected from the crosses:
 - (a) black X blue
 - (b) blue X blue
 - (c) blue X white

4. Two carnations (flowers), a red one and a white one, are crossed and the F₂ offspring have three different genotypes. If this gene shows incomplete dominance, what is the color of the heterozygous plants?

5. In guinea pigs, coat colour is determined by at least three alleles. Yellow is homozygous dominant, two other colours are also possible; white and ecru (cream-coloured). Which is the homozygous recessive colour?

Determine the expected genotype and phenotype ratio of the F₁ generation which would result from:

- (a) a cross between two cream-coloured guinea pigs
 - (b) a yellow-coated and cream-coated animal breeding
6. On a fox ranch, a mutation arose that gave a “platinum” coat colour that was very popular with fur buyers. The breeders couldn’t breed a pure strain of platinum foxes; every time they bred two platinum foxes together, there were some normal foxes in the progeny. For example, in repeated matings of the same platinum foxes, 82 platinums and 38 normal offspring were produced. State a concise genetic hypothesis to account for these results.

 7. In dogs, gum coloration is co-dominant, with black exerting dominance over pink. You have a lovely spotted gummed Labrador retriever who has just had 8 pups. Four of the pups have spotted gums like your dog, and 4 have pink gums. What is the likely phenotype of the sneaky neighbour dog?

Blood Types and Multiple Alleles

1. In a maternity ward, four babies become accidentally mixed up. The ABO blood types of the four babies are known to be: Baby Jane is O, Baby John is A, Baby Christopher is B, and Baby Robin is AB. The ABO types of the four sets of parents are determined as such: The Andersons are AB and O, the Browns are A and O, the Christiansons are A and AB, and the Dietrichs are O and O. Indicate which baby belongs to each set of parents.

Numerical Response

1. The probability that a mother with blood type O and a father with genotype $I^B i$ would have a child with blood type O is _____.

(Record your answer as a value from 0 to 1, rounded to two decimal places, in the numerical-response section on the answer sheet.)

2. In corn, pure lines are obtained that have either sun red, pink, scarlet, or orange kernels when exposed to sunlight. The following table gives the results of some of these crosses between lines. Analyze the results of each cross, and provide a dominance hierarchy for kernel colour in corn.

Cross	Parental phenotypes	F1 phenotypes	F2 phenotypes
1	sun red X pink	all sun red	66 sun red : 20 pink
2	orange X sun red	all sun red	998 sun red : 314 orange
3	orange X pink	all orange	1300 orange : 429 pink
4	scarlet X orange	all yellow	182 yellow : 80 orange : 58 scarlet

3. Multiple alleles control the coat colour of rabbits. A grey colour is produced by the dominant allele C. The C^{ch} allele produces a silver grey colour when present in the homozygous condition called chinchilla. When C^{ch} is present with a recessive gene, a light silver grey colour is produced. The allele C^h produces a white colour with black extremities called Himalayan. An allele C^a is recessive to all genes and results in the albino (non-pigmented condition). The dominance hierarchy is: $C > C^{ch} > C^h > C^a$. The following table shows the genotypes and phenotypes for rabbit coats:

Phenotypes	Genotypes
Full colour	CC, CC^{ch}, CC^h, CC^a
Chinchilla	$C^{ch}C^{ch}$
Light grey	$C^{ch}C^h, C^hC^a$
Himalayan	C^hC^h, C^hC^a
Albino	C^aC^a

- (a) Indicate the genotypes and phenotypes of the F1 generation from the mating of a heterozygous Himalayan coat rabbit with an albino coat rabbit.
- (b) The mating of a full colour rabbit with a light grey rabbit produces two full color offspring, one light grey offspring, and one albino offspring. Indicate the genotypes of the parents.

Numerical Response

2. The probability that a father with genotype ii and a mother with blood type AB would have a son with blood type B is _____.

(Record your answer as a whole number in the numerical-response section of the answer sheet.)

Dihybrid Cross Questions

1. What would be the expected phenotypic ratio of the F1 offspring if a heterozygous, tall round pea plant pollinated itself? Tall is dominant to short, and round is dominant to wrinkled in pea plants.
2. Long legs (L) in racing horses is dominant to short legs (l). Good muscle tone (G) is dominant to weak muscle tone (g). Determine the phenotypes of the F1 generation resulting from a cross between a heterozygous long legged, weak muscled horse and a heterozygous long legged, strong horse?
 - (a) Determine the phenotypes of the offspring if the genotypes of the mare was $LLGg$ and the stud was $LlGg$.
3. In poultry, a crested head is produced by a dominant gene (C) and plain head is its recessive allele (c). Black feather colour (B) is dominant to red feathers (b). A homozygous black feathered, plain headed bird is mated with a homozygous red feathered, crested headed bird.
 - (a) Determine the F1 genotypes and phenotypes.
 - (b) If the F1 birds were allowed to mate with each other, what phenotypic and genotypic ratios are expected from the F2 generation?

Use the following information to answer the next question.

In addition to the ABO system, human blood may be typed as Rh^+ or Rh^- . The blood types Rh^+ and Rh^- are controlled by the dominant allele R (Rhesus positive) and the recessive allele r (Rhesus negative).

Numerical Response

1. If a woman with the genotype $I^A I^B Rr$ and a man with the blood type O Rh^- have a child, what is the probability that the child will have blood type A Rh^- ?

Answer: _____

(Record your answer as a value from 0 to 1, rounded to two decimal places, in the numerical-response section on the answer sheet.)

Sex-Linked Questions

1. Red/ green colour blindness in humans is a sex-linked recessive trait. In a large family in which all the daughters have normal visions and all the sons are colourblind, what are the probable genotypes of the parents?
2. If a normal sighted woman whose father was colourblind marries colour blind man, what percentage of their sons will be colour blind? What percentage of their daughters will be colour blind?
3. If a normal woman carrying the sex linked gene for colour blindness marries a normal male, what percentage of their sons will be colour blind? What if she marries a colour blind male?
4. Baldness is a recessive sex-linked trait. If a normal headed woman whose father is bald, has children with a normal headed man, whose father was bald, what will be the genotypes and phenotypes of their children?

Gene Mapping Questions

1. The crossover frequency between genes *E* and *F* is 6%, between *E* and *G* is 10% and between *F* and *G* is 4%. Construct a gene map. Determine the sequence of genes on the chromosome.
2. In 1911, Thomas Morgan collected the following crossover gene frequencies while studying *Drosophila*. Bar-shaped eyes are indicated by the *B* allele, and carnation eyes are indicated by the allele *C*. Fused veins on wings (*FV*) and scalloped wings (*S*) are also located on the same chromosome.

Gene Combinations	Frequencies of Recombinations
<i>FV/B</i>	2.5%
<i>FV/C</i>	3.0%
<i>B/C</i>	5.5%
<i>B/S</i>	5.5%
<i>FV/S</i>	8.0%
<i>C/S</i>	11.0%

Construct a gene map. Determine the sequence of genes on the chromosome.

3. The following chart shows crossover frequencies for some genes on an autosome of organism Z. Construct a chromosome map. Order the genes on the chromosome.

<u>Genes</u>	<u>Crossover Frequency</u>
<i>P & Q</i>	5%
<i>P & R</i>	8%
<i>P & S</i>	12%
<i>Q & R</i>	13%
<i>Q & S</i>	17%

4. For a series of experiments, a linkage group composed of genes *W*, *X*, *Y* and *Z* was found to show the following gene combinations. (All recombinations are expressed per 100 fertilized eggs). Construct a gene map. Determine the sequence of genes on the chromosome.

Genes	<i>W</i>	<i>X</i>	<i>Y</i>	<i>Z</i>
<i>W</i>	–	5	7	8
<i>X</i>	5	–	2	3
<i>Y</i>	7	2	–	1
<i>Z</i>	8	3	1	–

5. For a series of experiments, a linkage group composed of genes *A*, *B*, *C* and *D* was found to show the following gene combinations. (All recombinations are expressed per 100 fertilized eggs). Construct a gene map. Determine the sequence of genes on the chromosome.

Genes	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
<i>A</i>	–	12	15	4
<i>B</i>	12	–	3	8
<i>C</i>	15	3	–	11
<i>D</i>	4	8	11	–

6. In *Drosophila*, the genes for eye colour (*pr*), wing shape (*vg*), and body colour (*eb*) are all found on the same chromosome. The following crossover frequencies for these genes were determined by experimentation.

<u>Genes</u>	<u>Crossover Frequency</u>
<i>pr & vg</i>	12.5%
<i>pr & eb</i>	6.0%
<i>vg & eb</i>	18.5%

Construct a gene map. Determine the sequence of genes on the chromosome.

7. Using the following chart, construct a gene map and determine the sequence of genes on the chromosome.

<u>Genes</u>	<u>Crossover Frequency</u>
<i>A & B</i>	24.0%
<i>A & C</i>	8.0%
<i>C & D</i>	2.0%
<i>A & F</i>	16.0%
<i>F & B</i>	8.0%
<i>D & F</i>	6.0%

8. Five traits found in *Drosophila* on the same chromosome are yellow body colour (*y*), white eye colour (*w*), vermilion eye colour (*v*), miniature wing (*m*) and rudimentary wing (*r*). Given the following crossover frequencies, construct a gene map and correctly order the genes on this chromosome.

<u>Genes</u>	<u>Crossover Frequency</u>
<i>y & w</i>	2.2%
<i>v & m</i>	3.0%
<i>v & r</i>	26.6%
<i>v & w</i>	30.0%
<i>v & y</i>	32.2%
<i>w & m</i>	33.0%
<i>y & m</i>	35.2%
<i>w & r</i>	56.6%