Unit 9 · Linkage and Crossing Over

WORKSHEET

Full marks 32

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 32

1 Key words [4]

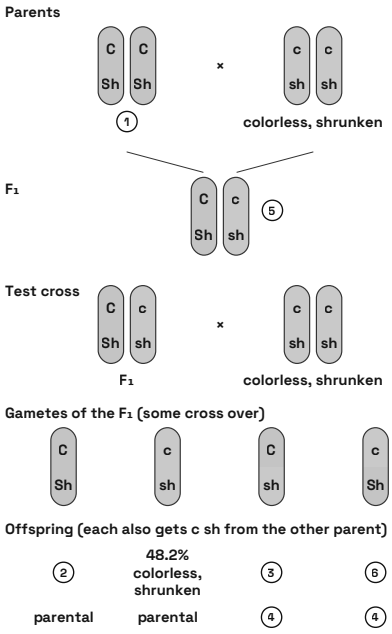
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

autosome	**carrier**	**centimorgan**	**chiasmata**	**epistasis**	**hemizygous**	**linkage**
linkage group	**non-sister**	**recombinant**				

The tendency of genes on the same chromosome to be inherited together is _____. All the genes on one chromosome form a _____. Offspring with new combinations of characters, not seen in the parents, are _____. The distance between two genes that gives 1% recombinant gametes is one map unit, or _____. A man has only one X chromosome, so for genes on it he is _____. A woman with one normal and one faulty X shows nothing but is a _____. Crossing over is an exchange between _____ chromatids of homologous chromosomes. The X-shaped joins where they exchanged pieces are _____.

2 Label the diagram [3]

The diagram shows Hutchinson's test cross of maize. Write the missing words or percentages for 1 to 6. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

5. _____ 6. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. A plant has 2n = 24 chromosomes. How many linkage groups does it have? [1]

a. 24 **b.** 12

c. 48 **d.** 2

ii. In a test cross of a double heterozygote, the offspring come in two kinds only, in a 1 : 1 ratio. What does this show? [1]

a. the genes are on different chromosomes **b.** the genes are completely linked

c. the genes are incompletely linked **d.** one gene is dominant over the other

iii. In which stage of meiosis does the actual exchange of genetic material take place? [1]

a. leptotene **b.** zygotene

c. pachytene **d.** diakinesis

iv. A man with hemophilia marries a woman with no hemophilia allele. Which of their children can have hemophilia? [1]

a. all the sons

b. half the sons

c. all the daughters

d. none of them; but every daughter is a carrier

v. Two genes are 3 map units apart on a chromosome. About what percentage of gametes are recombinant for them? [1]

a. 50% **b.** 30%

c. 3% **d.** 0%

4 Short answers [9]

Write short answers to the following questions.

a. Differentiate between complete and incomplete linkage. [2]

b. Why is red–green color blindness much more common in men than in women? [2]

c. A woman with normal vision whose father was color-blind marries a man with normal vision. What fraction of their sons can be color-blind? Show the cross. **[2]**

d. Write any three significances of crossing over. **[3]**

5 Numerical problem **[4]**

Show your working.

A maize plant heterozygous for two linked genes, CSh/csh, is test-crossed with a csh/csh plant. The seeds are 465 colored full, 455 colorless shrunken, 42 colored shrunken and 38 colorless full. Which classes are recombinant? Find the recombination frequency and the distance between the genes. A third gene, X, gives 3% recombinants with C and 11% with Sh. Draw the order of the three genes.

Answer:

6 Long answer [4]

Write a long answer to the following question.

Describe Morgan's Cross I and its reciprocal (Cross III) for eye color in *Drosophila*, and what they show.

7 Think [3]

A test cross of an F_1 male fruit fly (gray, normal wings) gives only two kinds of offspring, but the same test cross with an F_1 female gives four kinds. A student says the genes are completely linked in males and on different chromosomes in females. Is the student right? Explain.

8 Activity: Crossing over with paper strips (not marked)

Mark genes A and B at 2.5 and 7.5 cm on a red strip, and a and b at the same places on a blue one (two non-sister chromatids). Draw a number from 1 to 19 for where a crossover falls, cut both strips there, swap the ends and read them. Repeat 20 times; then move B to 14.5 cm and repeat.

Genes at	Crossovers	Recombinant (Ab, aB)	Parental (AB, ab)
2.5 and 7.5 cm	20		
2.5 and 14.5 cm	20		

Which pair of genes gave more recombinants, and why?