Crosses step by step, and a family tree

Names: Class: Date:

Work with a partner. The first cross is worked for you: read each step and check that you can see why it follows. Finish the last step of the second cross, then solve the last two yourselves, one step at a time.

PART 1 Punnett squares, step by step

In each square, one parent's gametes go along the top and the other parent's down the side.

1 · WORKED EXAMPLE

Mendel's first-generation pea plants were all Vv, where V, for violet flowers, is dominant to v, for white flowers. He let them self-fertilise, so each cross was Vv × Vv. What ratio of flower colours should their offspring have?

	V	v
V	VV	Vv
v	Vv	vv

Step 1. Each parent's gametes carry one allele, V or v, and the two are equally likely.

Step 2. The square gives four equally likely combinations: VV, Vv, Vv and vv.

Step 3. VV and Vv give violet flowers and vv gives white, so 3 violet : 1 white.

2 · FINISH THIS ONE

A Vv plant is crossed with a vv plant. What ratio of flower colours should the offspring have?

	v	v
V	Vv	Vv
v	vv	vv

Step 1. The Vv parent's gametes carry V or v, equally likely, and all the vv parent's gametes carry v.

Step 2. The square gives Vv, Vv, vv and vv.

Step 3. What ratio of flower colours?

3 · NOW SOLVE ONE YOURSELF

Two parents both carry the cystic fibrosis allele: they are Cc × Cc, where C is the usual allele and c the allele for cystic fibrosis. What is the chance that a child of theirs has cystic fibrosis?

Step 1. What can each parent's gametes carry?

Step 2. Fill in the square. What combinations does it give?

Step 3. What is the chance that a child has cystic fibrosis?

4 · AND ONE MORE

A woman who carries the haemophilia allele (XH Xh) has children with a man who doesn't have haemophilia (XH Y). Put the eggs down the side and the sperm along the top. What are the chances for their sons and for their daughters?

Step 1. What can the eggs carry, and what can the sperm carry?

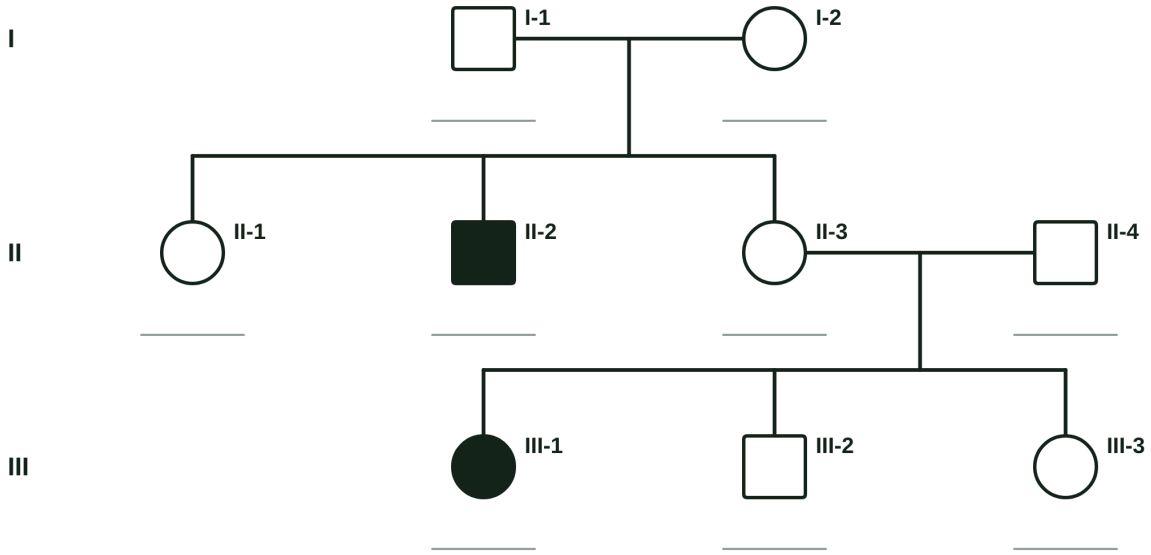
Step 2. Fill in the square. Which children are sons and which are daughters?

Step 3. What are the chances for the sons, and for the daughters?

PART 2 Reading a family tree

This family is made up. The condition is recessive. A is the usual allele and a the allele for the condition.

1. Write each person's genotype on the line under their symbol. When the tree can't show whether someone has a second A, write A?.
2. Answer the two questions.



Square: male. Circle: female. Filled: has the condition.

Question 1. I-1 and I-2 don't have the condition. How do you know that they are both carriers?

Question 2. What is the chance that the next child of II-3 and II-4 has the condition? Show how you worked it out.

Facts: OpenStax Biology 2e 12.1 to 12.3 (Mendel's peas, Punnett squares, dominant and recessive alleles, X-linked traits and carriers); Pregnancy, Birth and Baby (cystic fibrosis, and a 1 in 4 chance when both parents carry the gene); Haemophilia Foundation Australia (how haemophilia is passed on). The family tree is made up.

Answers (turn the page round). Cross 2: Vv, Vv, vv, so 1 violet : 1 white (2 violet and 2 white). **Cross 3:** each parent's gametes carry C or c; the square gives CC, Cc, Cc and cc; only cc has cystic fibrosis, so the chance is 1 in 4. **Cross 4:** the eggs carry XH or Xh and the sperm XH or Y; the square gives daughters XH XH and XH Xh, and sons XH Y and Xh Y; each son has a 1 in 2 chance of haemophilia, and each daughter a 1 in 2 chance of being a carrier. **The tree:** I-1 Aa, I-2 Aa, II-1 A?, II-2 aa, II-3 Aa, II-4 Aa, III-1 aa, III-2 A?, III-3 A?. **Question 1:** their son II-2 has the condition, so he has aa and got an a from each parent; neither parent has the condition, so each also has an A. **Question 2:** II-3 and II-4 are both Aa, because their daughter III-1 has the condition; Aa × Aa gives AA, Aa, Aa and aa, so the chance is 1 in 4.