SCIENCE FOUNDATIONS

Sex-linked inheritance

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you explain why colour blindness shows up far more often in boys than in girls, since the gene sits on the X chromosome that boys only get one copy of. A boy with one copy of the gene shows the trait, while a girl needs two copies to show it, so she is more likely to carry it without showing it. A family history of colour blindness on the mother's side tells a counsellor where to look. Knowing sex-linked inheritance tells you why some traits run mostly through one sex, and why a mother can pass a trait to her son without having it herself.



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Rule

Sex-linked inheritance: a male has only one X chromosome, so one recessive X-linked copy is enough for him to show the trait.

A female has two X chromosomes, so she needs two recessive copies to show it and is a carrier with one copy. That is why X-linked recessive traits are more common in males.

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Worked examples

EXAMPLE 1

Q A carrier mother (XHXh) and a normal father (XHY) have a son. Chance he has the trait?

	XH	Xh
XH	XHXH	XHXh
Y	XHY	XhY

SOLUTION

Sons get Y from father and one X from mother.

Mother passes XH or Xh equally: half the sons get Xh.

A son with XhY shows the trait.

The result is 1 in 2 chance (50 percent) for a son.

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EXAMPLE 2

Q Same parents have a daughter. Chance she has the trait?

	XH	Xh
XH	XHXH	XHXh
Y	XHY	XhY

SOLUTION

Daughters get XH from father and one X from mother.

Father's XH is dominant, so daughters do not show the trait either way.

Chance of showing it is zero, though half are carriers.

The result is 0 chance of showing; half are carriers.

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Practice questions

1 A normal mother (XHXH) and an affected father (XhY) have a son. What is the chance the son has the trait?

- **A** 0
- **B** 1 in 2
- **C** 1
- **D** 1 in 4

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2 A carrier mother (XHXh) and an affected father (XhY) have a son. What is the chance the son has the trait? Explain.

- **A** 0
- **B** 1 in 4
- **C** 1 in 2
- **D** 1

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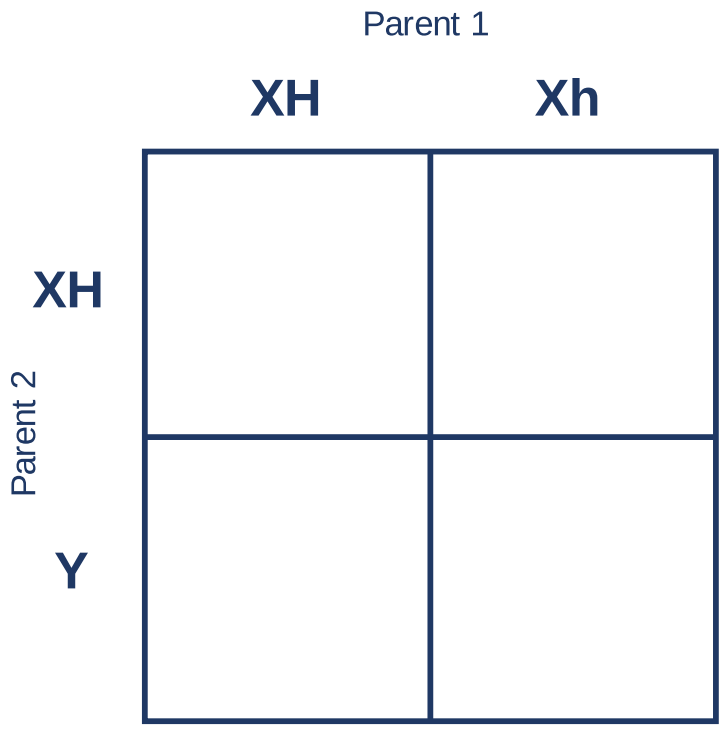
3 **An affected mother (XhXh) and an affected father (XhY) have a daughter. What is the chance the daughter shows the trait?**

- **A** 0
- **B** 1 in 4
- **C** 1 in 2
- **D** 1

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4 **A carrier mother (XHXh) and a normal father (XHY) have a daughter. What is the chance the daughter is a carrier? Explain. Use the Punnett square.**



A 1 in 4

B 1 in 2

C 0

D 1

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5

A male with one recessive X-linked copy: does he show the trait?

A Yes

B No

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6

A female has two recessive X-linked copies (XhXh). Does she show the trait?

A Yes

B No

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7 Why are X-linked recessive traits more common in males?

- **A** Males have only one X chromosome
- **B** Females have only one X chromosome
- **C** Males have two X chromosomes
- **D** Females pass the trait to sons only

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8 What is a carrier?

- **A** Someone with one recessive copy who does not show the trait
- **B** Someone with two recessive copies who shows the trait
- **C** Someone with no copies of the gene
- **D** A male who shows the trait

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9 A son gets his X chromosome from whom?

- **A** His father
- **B** Either parent
- **C** His mother
- **D** Neither parent

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10 A carrier mother and a normal father have a son. What is the chance the son is affected, and what is the chance a daughter is a carrier?

- **A** Son 1 in 2; daughter carrier 1 in 2
- **B** Son 1 in 4; daughter carrier 1 in 4
- **C** Son 1; daughter carrier 0
- **D** Son 0; daughter carrier 1

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ANSWER KEY

1. 0

2. 1 in 2

3. 1

4. 1 in 2

5. Yes

6. Yes

7. Males have only one X chromosome

8. Someone with one recessive copy who does not show the trait

9. His mother

10. Son 1 in 2; daughter carrier 1 in 2

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