

Many alleles, codominance and sex linkage

60 minutes • D3.2.8 to D3.2.12 • Chapters 7, 8, 9

Single-nucleotide polymorphisms and multiple alleles, the ABO blood groups, incomplete dominance and codominance, and the inheritance of genes on the sex chromosomes

BY THE END, STUDENTS CAN

- ☐ Describe single-nucleotide polymorphisms and multiple alleles in a gene pool D3.2.8
- ☐ Use the ABO blood groups to show how multiple alleles are inherited D3.2.9
- ☐ Distinguish incomplete dominance from codominance D3.2.10
- ☐ Explain sex determination in humans and the inheritance of genes on the sex chromosomes D3.2.11
- ☐ Use haemophilia to explain a sex-linked genetic disorder D3.2.12

TIMING

0–5	5 min	Do now	
5–15	10 min	Spot the SNP	
15–27	12 min	ABO and the baby swap	
27–37	10 min	Neither wins, or both do	
37–55	18 min	X, Y and sex	
55–60	5 min	Exit	
60 min		One lesson	

STARTER

- 5 min** **Do now**
- Chapter 7's first predict box. Ask students to write down what they think determines their blood group, then compare to the figure.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

07 Many alleles, not just two

CHAPTER 07 IN THE SLIDES

Step through the figure (4 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

- DNA from four people at one place. They differ at a single base: a **SNP**.
- Across a whole population a gene can have many **alleles**. The **gene pool** holds them all.
- Each person inherits just **two** of them.
- ABO: three alleles in the pool give six genotypes and four blood groups.

Predict box: A man with blood group AB ($I^A I^B$) and a woman with group O (ii) have children. Which groups are possible? Hands up or mini whiteboards first.

Answer C: A and B only

Remember it: Apple Banana Both Orange (Group A, Group B, Group AB, Group O).

08 Neither wins, or both do

CHAPTER 08 IN THE SLIDES

Step through the figure (3 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. **Incomplete dominance** in four o'clocks: red ($C^R C^R$), pink ($C^R C^W$) and white ($C^W C^W$). The heterozygote is intermediate.
2. Cross two pink plants and the offspring are **1 red : 2 pink : 1 white**. The phenotype ratio matches the genotype ratio, and red and white reappear.
3. **Codominance** in blood: a red blood cell of group AB carries both markers, so the heterozygote has a dual phenotype.

Predict box: A red four o'clock plant is crossed with a white one. What colour are the F1 flowers? Hands up or mini whiteboards first.

Answer C: All pink

09 X, Y and sex

CHAPTER 09 IN THE SLIDES

Step through the figure (3 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. The **X** is big and carries many genes. The **Y** is small and carries far fewer. Two Xs develop female, an X and a Y develop male.
2. Every egg carries an X. A sperm carries X or Y, so the **sperm decides** the sex: half girls, half boys.
3. **Haemophilia**: a carrier mother ($X^H X^h$) and an unaffected father ($X^H Y$). Half the sons have haemophilia and half the daughters are carriers. No daughter is affected.

Predict box: A man with haemophilia ($X^h Y$) and a woman who is not a carrier ($X^H X^H$) have children. What are the children like? Hands up or mini whiteboards first.

Answer C: All daughters are carriers; all sons are unaffected

THE LESSON

10 Spot the SNP

min

Chapter 7's figure on SNPs, then the DNA strip activity below. Students find the single-letter differences and say which differences change the polypeptide and which do not.

12 ABO and the baby swap

min

The ABO table in [chapter 7](#) and the Remember it tiles. Then the hospital cases below: could this baby belong to these parents? Insist on genotypes written out with the I and i symbols.

10 Neither wins, or both do

min

Chapter 8's figure. Students put the two flower crosses side by side and name the pattern in each. Ask: what is the difference between the heterozygote that is a blend and the one that shows both?

18 X, Y and sex

min

Chapter 9's figure and the crosses below. Students set out X and Y with their superscripts, read the sons and daughters of each cross, and say what fraction of each sex is affected.

ACTIVITIES



PUZZLE

Spot the SNP

Three strips of invented DNA, about 30 letters each, from three people. Pairs lay them over each other, ring the letters that differ, and count them. Ask: what is a single-nucleotide polymorphism? Then, for each difference: does it change a codon, and does the change alter the amino acid? Use the codon table. Close with the point that a SNP is a difference found in at least 1 percent of the population, and so is not simply any mutation.

Needs: printed strips, a codon table.



CASE CARDS

The baby swap

Six hospital cases: one baby, two possible parents, and their blood groups. Could the baby belong to them? (1) Mother A, father B, baby O. *Possible, if both are heterozygous.* (2) Mother O, father O, baby AB. *Not possible.* (3) Mother AB, father O, baby A. *Possible.* (4) Mother AB, father AB, baby O. *Not possible.* (5) Mother B, father A, baby AB. *Possible.* (6) Mother O, father AB, baby O. *Not possible.* Students write each possible genotype pair and the cross before they answer, and say which result would rule out a pair for certain.

Needs: printed cards, one set per pair.



PRACTICE

Colour blindness and haemophilia

Four crosses. Use X with a superscript for each allele: X^H and X^h for haemophilia. (1) A carrier mother by an unaffected father. *Half the sons affected, no daughters affected, half the daughters carriers.* (2) An affected father by a mother who is not a carrier. *No sons affected, all daughters carriers.* (3) An affected father by a carrier mother. *Half the sons and half the daughters affected.* (4) An unaffected father by a mother who is not a carrier. *No affected children and no carriers.* Repeat (1) and (2) for red-green colour blindness, which is also carried on the X chromosome. Ask why a son cannot inherit an X-linked condition from his father.

Needs: mini whiteboards.

PLENARY

5
min

Exit

A father with haemophilia and a mother who is not a carrier: write the cross and the chance that a son or a daughter is affected. Collect.

WHAT STUDENTS GET WRONG

Incomplete dominance is "blending". The red and white alleles are not mixed up or lost: they come apart again in the next generation, so red and white can reappear.

"An individual has three ABO alleles." A person has two of the three alleles in the population, one from each parent. Three is the number in the gene pool.

A son can inherit an X-linked condition from his father. A father gives his son a Y chromosome. The son's X comes from his mother.

"Every X-linked condition affects only boys." Daughters can be affected, but need two copies of the recessive allele.

STRETCH AND SUPPORT

Support: give each figure's captions as a cut-up storyboard to put in order, and let students tap the dotted words as a glossary.

Support: a table of the four ABO phenotypes and their genotypes on the desk.

Stretch: a woman has blood group A and a child with blood group O. What can you say for certain about her genotype, and about the father's?

IN THE GUIDE

- 7 [Many alleles, not just two](#)
- 8 [Neither wins, or both do](#)
- 9 [X, Y and sex](#)
- A11 [The whole guide, with the figures that play](#)
- PPTX [This lesson's slides, in the order of this plan](#)

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- [Tarsia puzzle, dominoes and picture reveal](#) on D3.2, built from its key terms and ready to print
- A [pub quiz](#) with rounds on D3.2, to present or run with no projector
- An [escape room built from the question bank](#) on D3.2

ALREADY ON THE SITE FOR D3.2

- Lesson: [Linked Genes & Chi-Squared](#)
- Lesson: [Dihybrid Crosses & Test Crosses](#)
- Lesson: [Inheritance](#)
- Summary doodle: [Inheritance](#)
- Quiz: [Inheritance \(HL\)](#)
- Quiz: [Inheritance](#)
- Revision map: [D3.2 Inheritance](#), to fill in
- Exam questions: [D3.2 in the exam maker](#), a paper with its markscheme

CARD SETS ON SPLYCR

Open a set to host it as a class game, or make a copy to edit.

- [D3.2 Inheritance](#)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on D3.2 at standard level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=D3.2&level=SL&paper=quiz&marks=15&src=ep



How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.