

# Dominance, plasticity and PKU

60 minutes • D3.2.5 to D3.2.7 • Chapters 4, 5, 6

Why a heterozygote can look like one homozygote, how the environment changes which genes are expressed, and phenylketonuria as a disease of a recessive allele

## BY THE END, STUDENTS CAN

- ☐ Predict the effects of dominant and recessive alleles on phenotype D3.2.5
- ☐ Explain phenotypic plasticity as a change in gene expression, not in the genes themselves D3.2.6
- ☐ Explain phenylketonuria as a disease caused by a recessive allele D3.2.7

## TIMING

|       |        |                                      |                        |
|-------|--------|--------------------------------------|------------------------|
| 0-5   | 5 min  | Do now                               | <div><div></div></div> |
| 5-20  | 15 min | Dominant and recessive, and the grid | <div><div></div></div> |
| 20-32 | 12 min | Same genes, different outcomes       | <div><div></div></div> |
| 32-52 | 20 min | One faulty enzyme: PKU               | <div><div></div></div> |
| 52-60 | 8 min  | Exit                                 | <div><div></div></div> |
|       | 60 min | One lesson                           |                        |

## STARTER

- 5 min** **Do now**
- Chapter 4's first predict box. Vote with fingers (1, 2 or 3) for the option, then reveal. Leave the votes on the board for 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.

## 04 Dominant and recessive alleles

CHAPTER 04 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.

- Three genotypes of the seed colour gene: two **homozygous** and one **heterozygous**.
- Each gene makes a protein. A **Y** allele makes a working one, and one working copy makes **enough** to give the trait. With no working copy, the trait changes.
- The phenotypes: **YY** and **Yy** are both yellow, so the dominant allele shows in a heterozygote. Only **yy** is green.

**Step through the figure** (2 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

- Each parent makes gametes by meiosis, one allele of each gene in each. The female parent's go down the side of the **Punnett grid**, the male parent's along the top.
- Each cell joins one gamete from each parent: a possible offspring, every cell as likely as the next. The F1: genotypes all Yy; phenotypes all yellow.

**Predict box:** Two yellow-seeded pea plants are crossed, and some of their offspring have green seeds. What must be true of both parents? Hands up or mini whiteboards first.

**Answer B: Both are heterozygous Yy: each carries a hidden y allele**

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## 05 Same genes, different outcomes

CHAPTER 05 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.

1. One parent plant, with its alleles.
2. Two **cuttings** from it carry exactly the same alleles.
3. One cutting grows in **sun** and one in **shade**. Same alleles, but different gene expression makes a short, sturdy plant and a tall one with broad leaves.
4. Move the shaded plant into the sun, and its **new growth** comes in like the sun plant's. The change is reversible, and the alleles never changed.

**Predict box:** Two clones grow differently, one in sun and one in shade. What explains the difference? Hands up or mini whiteboards first.

**Answer B: The light changed how their genes were expressed**

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## 06 One faulty enzyme: PKU

CHAPTER 06 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.

1. In a person with a working allele, the **enzyme** converts phenylalanine to tyrosine, which has one extra OH group.
2. In a person with two faulty alleles the enzyme does not work. Little tyrosine is made and **phenylalanine builds up**.
3. A **diet low in phenylalanine** gives the body less to build up. The genotype is the same, and the phenotype changes.
4. Two **carrier** parents (Nn): each child has a 1 in 4 chance of nn, so of PKU.

**Predict box:** Two parents do not have PKU, but their first child does. What is the chance that their second child has PKU? Hands up or mini whiteboards first.

**Answer C: 1 in 4, because both parents must be carriers**

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### THE LESSON

**15**

min

#### Dominant and recessive, and the grid

Chapter 4's figure and the cross builder under it. Students predict each result before the grid fills in. Then the practice below, in pairs: six crosses, each set out with gametes, grid, genotype ratio and phenotype ratio.

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**12**

min

#### Same genes, different outcomes

Chapter 5's figure. Show the cress seedlings, or photographs of them, from the practical below (set up the week before, or use the photographs on the card). Ask: do the two trays have the same genes? Land on "the genes were the same; what differed was which were expressed".

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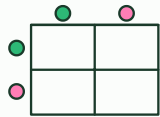
**20**

min

#### One faulty enzyme: PKU

Chapter 6's figure, step by step, then the two-carrier cross at the board. Then the case cards below, in groups: each card describes a family and asks for the chance that a child has PKU. Finish with screening and diet.

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## PRACTICE

## Six crosses

Six crosses, each with two parents, the gametes, a Punnett grid, the genotype ratio and the phenotype ratio. Use pea seed colour (Y yellow dominant, y green): (1) YY by yy. *All Yy, all yellow.* (2) Yy by yy. *1 Yy : 1 yy, 1 yellow : 1 green.* (3) Yy by Yy. *1 YY : 2 Yy : 1 yy, 3 yellow : 1 green.* (4) yy by yy. *All green.* (5) A yellow plant by a green gave 18 yellow and 20 green offspring: what was the yellow parent? *Yy.* (6) Two yellow plants gave some green offspring: give the genotypes of both parents and the chance of a green seed. *Both Yy; one in four.* Finish by asking what would be different if you counted 8 offspring instead of 800.

**Needs:** mini whiteboards or squared paper.

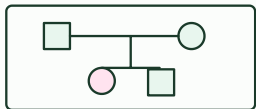


## PRACTICAL

## Cress in the dark and the light

Sow cress seeds in two trays of damp cotton wool. Put one on a windowsill and the other in a cupboard, and water both. After a week, students record height, colour and leaf size, then answer: the seeds were from one packet, so why do the trays differ? Move the pale tray into the light and watch it for three days. Which parts of the seedling change, and which parts do not? Link to [chapter 5](#): expression changes, the alleles do not. Photographs on the board are an acceptable substitute if no cupboard is free.

**Needs:** cress seeds, trays, cotton wool, a dark cupboard and a windowsill, a ruler; set up a week ahead.



## CASE CARDS

## PKU in the family

Six cards, each a short invented family: two unaffected parents and a child with PKU; two parents who both have PKU; one parent who is a carrier and one who has two normal alleles; and so on. Groups set out the genotype of each parent with N for the normal allele and n for the PKU allele, draw the cross, and give the chance of a child with PKU. Add a question about how the disease would be found at birth and what a family does about it. Keep every card invented and avoid naming real people.

**Needs:** printed cards, one set per group.

## PLENARY

8

min

## Exit

On a slip: the chance that the child of two carriers is a carrier, and the chance that it has PKU. Then one sentence on why a low phenylalanine diet helps.

#### WHAT STUDENTS GET WRONG

**"Dominant means common or strong."** A dominant allele is one that shows in the heterozygote. Many dominant alleles are rare, and some harmful ones are dominant.

**"Recessive alleles disappear."** A recessive allele stays in a heterozygote, hidden, and can come back in a later generation. Return to PKU carriers.

**"A Punnett grid predicts exactly."** It gives a probability for each child. Four children from Yy by Yy need not include a green one. Use the coins.

**Plasticity is inheritance of acquired characteristics.** A plant that grows tall in the shade does not give its seeds taller genes. The same alleles are expressed differently in a different environment.

#### 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 Punnett grid with the gametes already written in for the first two crosses.

**Stretch:** why can a recessive disease stay common in a population even though the affected cannot easily have children? Link to the carriers in [chapter 6](#).

#### IN THE GUIDE

- 4 [Dominant and recessive alleles](#)
- 5 [Same genes, different outcomes](#)
- 6 [One faulty enzyme: PKU](#)
- 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](https://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.