

A spread, not a few types

60 minutes • D3.2.14 and D3.2.15 • Chapters 11, 12

Continuous variation from polygenic inheritance and the environment, and drawing and reading box-and-whisker plots

BY THE END, STUDENTS CAN

- ☐ Explain continuous variation as the result of polygenic inheritance and the environment D3.2.14
- ☐ Draw and read box-and-whisker plots for a continuous variable such as student height D3.2.15

TIMING

0–5	5 min	Do now	
5–20	15 min	The six-coin model	
20–30	10 min	Discrete and continuous	
30–52	22 min	Box-and-whisker plots	
52–60	8 min	Exit and linking question	
60 min		One lesson	

STARTER

5 min Do now

Where does your height fall, compared with the class? Students put a sticky note on an anonymous number line. Do they sit in two groups or form a hill? Why?

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.

11 A spread, not a few types

CHAPTER 11 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.

- Discrete** variation: the bars are separate, because nobody is halfway between two blood groups.
- A simple model of a **polygenic** trait: six alleles, each lighter or darker. Combinations with three darker alleles are commonest, and the extremes are rare.
- Add the **environment** and the steps blur into a smooth, **continuous** spread.

Predict box: Which of these shows discrete variation? Hands up or mini whiteboards first.

Answer B: The blood groups of students in a class

12 Showing a spread with a box plot

CHAPTER 12 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.

- 25 student heights, one dot each (made up). Where is the middle, and how spread out are they?
- The box runs from **Q1** to **Q3** with the **median** marked. The whiskers run to the smallest and largest values that are not outliers.
- IQR** = $172 - 160 = 12$. The fences lie $1.5 \times \text{IQR}$ beyond the box, at 142 and 190.
- A value beyond a fence is an **outlier**: 194 is above 190, so it is plotted on its own.

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

1. Heights of 25 students in one class (made-up data). Height varies **continuously**: each dot is one student, and the values spread out with most near the middle.
2. The **box** runs from Q_1 (160) to Q_3 (172) with the **median** (166) inside; the whiskers reach the furthest values within 1.5 x IQR of the box (the dashed fences, 142 and 190). Beyond them, 194 is an **outlier**.

Predict box: In a box plot, what fraction of the data lie inside the box? Hands up or mini whiteboards first.

Answer B: One half

THE LESSON

15

min

The six-coin model

The activity below. Each student flips six coins to build a "genotype" for a polygenic trait and the class builds the bar chart of totals. Compare with one coin and the two groups it gives.

10

min

Discrete and continuous

Chapter 11's figure. Students sort the traits on the card: blood group, tongue rolling, height, skin colour, hand span, number of petals. Ask what skin colour needs, besides several genes, to give a smooth spread.

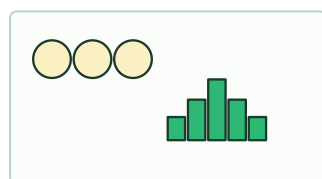
22

min

Box-and-whisker plots

Chapter 12's figure and the box plot tool. Then the hand span task below: collect anonymous measurements, find the median and quartiles, draw the plot by hand and check it with the tool. Ask which values are outliers and what the 1.5 times IQR rule says.

ACTIVITIES

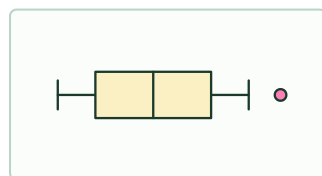


MODEL

The six-coin model

Each student has six coins, one for each of six genes. Heads is an allele that adds one unit of pigment, tails adds none. Flip all six, count the heads, and add a mark to the class bar chart (0 to 6). Then try again with one coin, and with the six coins plus a second round in which "sun" adds or removes one unit for a random half of the students. What shape does the chart have each time? Link to skin colour: many genes, each with a small effect, plus the environment.

Needs: six coins per student, a class tally chart.



DATA TASK

Hand spans and box plots

Students measure their hand span in centimetres and write the number on a slip, with no names. Pool the numbers on the board, then in groups find the median and the quartiles, work out the interquartile range, and set the fences at 1.5 times the range above Q_3 and below Q_1 . Draw the box-and-whisker plot by hand, mark any outlier, and check against the box plot tool. Ask what a plot tells you that a mean does not. Offer a second data set (an invented one of 25 heights) to test the rule on a clear outlier.

Needs: rulers, squared paper, a pooled table on the board.

PLENARY

8

min

Exit and linking question

What are the principles of effective sampling? Ask for two: a large enough sample, and one chosen so it represents the population. Then one sentence on why a class is a poor sample of all students.

WHAT STUDENTS GET WRONG

Continuous variation is only caused by the environment. Several genes, each with a small effect, give a smooth spread even before the environment adds to it.

Outliers should be deleted. A box plot marks them so the reader can see them. Remove one only if you can show it was a mistake.

STRETCH AND SUPPORT

Support: step-by-step boxes for finding the median and quartiles, with a worked example.

Stretch: how might you tell a hill-shaped spread caused by the environment from one caused by several genes? Think about family data.

IN THE GUIDE

- 11** [A spread, not a few types](#)
- 12** [Showing a spread with a box plot](#)
- A11** [The whole guide, with the figures that play](#)
- PPTX** [This lesson's slides, in the order of this plan](#)

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



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](#)

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.