

Gene pools and neo-Darwinism HL

60 minutes • D4.1.9 to D4.1.11 • Chapters 7, 8

Describing a population by its allele frequencies, and defining evolution as a change in them

BY THE END, STUDENTS CAN

- ☐ Describe a gene pool, and calculate and compare allele frequencies in a population, using a database for a human example D4.1.9, D4.1.10
- ☐ Explain neo-Darwinism: how selection between individuals changes allele frequencies in the gene pool D4.1.11

TIMING

0-6	6 min	Do now: marbles in a bag	
6-16	10 min	The gene pool	
16-34	18 min	Search a database	
34-48	14 min	Selection by hand	
48-55	7 min	Watch ICE AGE again	
55-60	5 min	Exit	
	60 min	One lesson	

STARTER

6
min

Do now: marbles in a bag

Pairs get a bag of 20 coloured marbles for one gene. Count the alleles of each colour and write the frequency of each as a decimal. Do the two frequencies add to 1? Compare bags across the room.

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 The gene pool

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.

- Ten individuals, each carrying **two alleles** of one gene: allele A in green, allele a in pink.
- Tip every allele into one jar: the **gene pool**, 20 alleles, 14 of them A and 6 of them a.
- The **allele frequency** of A is 14 out of 20, which is 0.7. The frequencies of A and a add to 1.
- A second population, cut off from the first, has **different** frequencies: 0.4 and 0.6.

Predict box: A population of 50 diploid individuals has 30 copies of allele B in its gene pool. What is the frequency of B? Hands up or mini whiteboards first.

Answer B: 0.30, because there are 100 alleles in the pool and 30 are B

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. Twenty beetles, each with two alleles of a jaw gene. Across the population, J and j are equally common: **p = 0.5**.
2. A drought leaves only tough seeds. The four **jj** beetles cannot feed and do not breed.
3. Count the alleles of the 16 survivors: 20 J and 12 j. The frequency of J is now **0.625**.
4. The survivors breed, so their gene pool is the next generation's. **The allele frequency has changed: evolution.**

Play the animation, Watch it happen: allele frequencies shift. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. **Inherited variation.** Jaws differ, set by the two alleles of a jaw gene that each beetle carries (the pips): pink J large, green j slender.
2. **Competition.** Twelve beetles leave thirty-six young, three times as many as the ground can feed.
3. **Environmental pressure.** A drought leaves only tough seeds. Large jaws crack them; slender jaws cannot, and those beetles starve.
4. **Adaptation.** The twelve survivors all have large or medium jaws, the trait that suits a dry year. Every one carries J.
5. **Genotype frequencies change.** Only survivors breed, so the allele frequency of J rises in generation 2.
6. **Evolution.** The dry years go on. By generation 5 nearly every beetle has large jaws: no beetle changed, the population did.

Predict box: In the beetle example, the J share of the gene pool was 0.5 before the drought and 20 of the 32 alleles of the survivors. What is it among the survivors? Hands up or mini whiteboards first.

Answer A: 0.625, because 20 of the 32 surviving alleles are J

THE LESSON

10 min **The gene pool**

Chapter 7's figure and its predict box (count alleles, not individuals). Define gene pool and allele frequency, and note the isolated populations in the last step.

18 min **Search a database**

The database task below: students find one allele in two populations from different regions, write down both frequencies and suggest a reason for the difference. A fixed table is on the card if the database is not available.

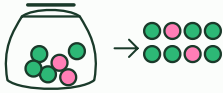
14 min **Selection by hand**

Chapter 8's figure, with the marbles: pairs lay out the twenty beetles as 40 marbles, take out every jj pair, then recount the survivors' alleles. Check the frequency of J against the figure's 0.625. Define neo-Darwinism: Darwin plus genetics.

7 min **Watch ICE AGE again**

The higher level ICE AGE film in chapter 8. Where is the allele frequency in each letter? Ask: why did no individual evolve?

ACTIVITIES



MODEL · HL

Marbles in a bag

Part 1 (the Do now): pairs share a bag of 20 marbles for one gene, green allele A and pink allele a. They count the alleles, write each frequency as a decimal and check that the two add to 1. Part 2 (lesson step three): pairs lay out [chapter 8's](#) population with 40 marbles, 20 green J and 20 pink j, in twenty pairs (4 JJ, 12 Jj, 4 jj). They take out every jj pair, recount the survivors' alleles and find the new frequency of J. Ask what happened to the individuals, and what to the gene pool.

Needs: coloured beads or marbles in two colours, small bags, a table for the counts.

place	allele	freq.

DATA TASK · HL

Search a database

Students open a human allele frequency database your school can reach and find one allele (the sickle-cell allele of the beta haemoglobin gene is a good one) in two populations from different regions. They write both frequencies, say which is higher, and suggest a reason (malaria is the usual one for the sickle allele). If the database is not available, give the table in [chapter 7](#) and ask the same questions.

Needs: devices with internet access, a recording sheet with space for two populations and the source.

PLENARY

5
min

Exit

Write a definition of evolution in terms of allele frequency, and an example from today in one sentence.

WHAT STUDENTS GET WRONG

Counting individuals instead of alleles. 50 diploid individuals hold 100 alleles of a gene, not 50.

STRETCH AND SUPPORT

Support: a worked example of allele counting for a population of five individuals on the board.

Stretch: the sickle allele is common where malaria is common. Why does the heterozygote's advantage stop it from being removed?

IN THE GUIDE

- 7** [The gene pool](#)
- 8** [Selection shifts allele frequencies](#)
- 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 D4.1, built from its key terms and ready to print
- A [pub quiz](#) with rounds on D4.1, to present or run with no projector
- An [escape room built from the question bank](#) on D4.1

ALREADY ON THE SITE FOR D4.1

- Lesson: [Hardy-Weinberg & Chi-Squared](#)
- Quiz: [Natural Selection \(HL\)](#)
- Quiz: [Natural Selection](#)
- Revision map: [D4.1 Natural selection](#), to fill in
- Exam questions: [D4.1 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.
- [D4.1 Natural Selection](#)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on D4.1 at higher level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=D4.1&level=HL&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.