

Fitness, heritability and choosing a mate

60 minutes • D4.1.5 to D4.1.7 • Chapters 4, 5

Fitness as survival and reproduction, why only heritable traits are selected, and sexual selection as a pressure of its own

BY THE END, STUDENTS CAN

- ☐ Use fitness, adaptation, survival and reproduction to explain why some individuals leave more offspring than others D4.1.5
- ☐ Explain why only heritable traits can be selected, and why traits acquired in a lifetime cannot D4.1.6
- ☐ Explain how competing for mates and being chosen drive the evolution of traits such as the plumage of birds of paradise D4.1.7

TIMING

0-5	5 min	Do now	
5-13	8 min	Fitness is offspring	
13-28	15 min	Chopsticks	
28-38	10 min	Run a population	
38-53	15 min	Compete or choose?	
53-60	7 min	Exit	
	60 min	One lesson	

STARTER

- 5 min Do now**
- Chapter 4's first predict box: the cat that lived 15 years with no surviving kittens, against the cat that lived 6 years with eight. Vote, then defend the vote. Leave the votes up until 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 Who survives, who breeds

CHAPTER 04 IN THE SLIDES

Step through the figure (5 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

- Three birds, and how many years each **lived**.
- And how many young each raised that reached **breeding age**.
- The bird that lived least has the **highest fitness**. Survival matters only because it lets an animal reproduce.
- A parent grew large on extra food. Its DNA bases are the same as before: the size was **acquired**.
- The chick inherits the same bases and hatches a normal size: an acquired trait is **not heritable**.

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

- Birds spot the beetles that stand out. The **best hidden** survive and breed.
- Then soot from a fire darkens the ground. Now the **pale** beetles stand out.
- No beetle ever changed its shell. The **population** changed: that is evolution.

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. Generation 1: the beetles' jaws vary, slender to large, and each carries two copies of the jaw gene (the pips: pink for large, green for slender). Which letter is this?
2. A drought leaves only tough seeds: who cracks them, and who starves? Predict before you run it.
3. Three dry years on. What has happened to the population, and to any one beetle?

Predict box: A cat lives 15 years but raises no surviving kittens. A second cat lives 6 years and raises 8 kittens that all breed. Which has the higher fitness? Hands up or mini whiteboards first.

Answer A: The second, because it left more offspring that went on to breed

05 Choosing a mate

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. Four males of one species, with **plumes** of different lengths.
2. A female looks them over, and **chooses** the longest plume.
3. The male she chooses sires the **most young**, and they inherit his alleles for a long plume.
4. But a long plume has a **cost**: it spreads only while the extra young outweigh the extra risk.

Predict box: A male's bright tail makes him easier for predators to catch. How can the trait still spread through the population? Hands up or mini whiteboards first.

Answer B: Only if the extra matings it brings outweigh the extra risk of being caught

THE LESSON

8 min Fitness is offspring

Chapter 4's figure, steps 1 to 3, then the acquired steps 4 and 5 with the weight-lifter predict box. Write the definition of fitness only after the figure. Ask: why is an acquired trait not heritable? (not encoded in the base sequence of the gametes' genes).

15 min Chopsticks

The practical below: students are birds with a utensil for a beak, and the food is something small and slippery. Three rounds, with the successful utensils becoming commoner each round. Then tie it to ICE AGE on the board.

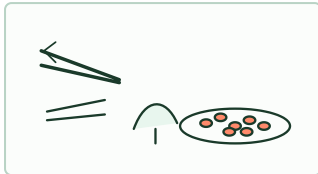
10 min Run a population

The ICE AGE game, in pairs, rounds on the letters and on the heritable case. Take notes on any round where pairs disagree and discuss it in the plenary. The peppered moth game is the alternative for classes that know the story.

15 min Compete or choose?

Chapter 5's figure and predict box, then the card sort below: intrasexual (compete) or intersexual (choose). Press on the costs: what is the price of a long tail, and when is it worth paying? Birds of paradise are the example to name in an answer.

ACTIVITIES

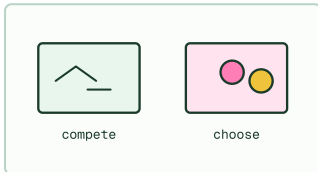


PRACTICAL

Chopsticks

Students are birds with a utensil for a beak: chopsticks, tweezers, a spoon, a clothes peg. A dish of small slippery food is the island. Each bird has 20 seconds to move as much food as it can into a cup. Birds that move less than a set number do not breed; the rest each "have chicks" that use the same utensil. Run three rounds with the new generation and tally the utensils. Which beak is commoner each round, and why? Then name each letter of ICE AGE in the activity.

Needs: five kinds of utensil, enough for every student to have one; a dish of dried beans or rice; cups; a timer; a tally table on the board.



CARD SORT

Compete or choose?

Eight cards for pairs: stags clashing antlers, a peahen picking between displaying males, frogs calling, males defending a territory, females comparing song, males wrestling over a nest, birds of paradise dancing for visiting females, and males displaying at one another. Sort into intrasexual (members of one sex compete) and intersexual (one sex chooses), and add a cost for each.

Needs: printed cards, one set per pair.

PLENARY

7
min

Exit

Two sentences: one that explains why the male with the largest antlers may not be the one with the highest fitness, and one that uses the word "heritable".

WHAT STUDENTS GET WRONG

"Fittest means strongest." It means most offspring that survive to breed. The small, plain animal with six young is fitter than the powerful one with none.

Acquired traits are inherited. Muscles, scars and the effects of extra food are not encoded in the base sequence of the genes in the gametes.

Sexual selection is "survival of the fittest". It can lower survival. What it raises is mating success.

STRETCH AND SUPPORT

Support: give the captions of each figure as a cut-up storyboard to put in order, and use the key terms (tap the dotted words) as a glossary.

Support: the ICE AGE tiles (Icy Cubs Eat Anything, Growing Enormous) on the board for every lesson.

Stretch: a costly display can be an honest sign of health because it is hard to fake. What would stop a weak male from faking it?

IN THE GUIDE

- 4** [Who survives, who breeds](#)
- 5** [Choosing a mate](#)
- 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 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=D4.1&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.