

Natural Selection & the Peppered Moth

Simulation: edtechsims.com/natural-selection-of-peppered-moths

Name: _____ Class: _____ Date: _____



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By the end of this activity, you should be able to:

- define natural selection and state the conditions needed for it to occur
- explain how industrial pollution changed the selection pressure on peppered moths
- interpret population frequency graphs from a simulation
- explain how a change in the environment leads to a change in allele frequency over generations

Part A: Pre-Activity (15 minutes)

1. Natural Selection — Core Concepts

1(i) What is natural selection?

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1(ii) What are the conditions necessary for natural selection? Check relevant conditions.

- ☐ variation exists within the population
- ☐ the variation is heritable (genetic)
- ☐ more offspring are produced than can survive
- ☐ there is competition / a selection pressure (e.g. predation)
- ☐ individuals with advantageous variations survive and reproduce more (differential survival and reproduction), passing on their alleles.

2. Human Activity & Industrial Melanism

During the Industrial Revolution, coal soot blackened tree bark across England, effectively flipping the selection pressure overnight on an evolutionary timescale.

Video: **Peppered Moths, BBC News** — <https://www.youtube.com/watch?v=ndD7XtLraFw>

2 If you were a bird hunting moths on soot-blackened bark, which moths would you eat more of — and why?

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Part B: Activity Section (30 minutes)

On the sim: In pairs, work through the guided activities in the simulation. Spend roughly 5 minutes on each question.

B1 Baseline Hunt — Run 3 manual generations in the light birch environment and record your observations. Which moth type was harder to spot?

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B2 Industrial Revolution Shift — Switch to the industrial (dark bark) environment. Compare auto-simulated outcomes across both environments. Which is the dominant form for each environment?

Environment	Dominant form	Why this form is favoured
Light birch		
Industrial (dark bark)		

B3 You vs. Natural Selection — For one environment, run the ten generations manually by hunting the moths through clicking. Then, run the auto-simulation. Is there any hunting bias compared with the computer's probability-driven selection? What does this mean about consistent vs. inconsistent predator behaviour?

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B4 Reading the Graph — Analyse the population frequency graphs for both environments. Identify the start and end percentages and the steepness of the selection curves.

Environment	Favoured form: start %	Favoured form: end %	Steepness of curve
Light birch			
Industrial (dark bark)			

What does a steeper curve tell you about the selection pressure?

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B5 Mutation and Variation — At the end of a light birch forest environment activity, does the less-favoured form disappear completely? Why or why not?

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B6 Check Your Understanding — Close this activity section by completing the Check Your Understanding quiz in the simulation.

My score: _____ / _____

Part C: Post-Activity (15 minutes)

Learn more than just industrial melanism! In pairs, research other well-documented examples of natural selection in action:

- **Antibiotic resistance in bacteria** — rapid selection under extreme pressure, directly parallel to the moth simulation
- **Beak variation in Darwin's finches** — directional selection driven by food availability
- **Sickle cell anaemia in malaria-endemic regions** — balancing selection where the heterozygote has a survival advantage
- **Guppy colouration in Trinidad** — predation pressure selecting for drab vs. bright colouration depending on predator presence

For each example, identify the selection pressure, the variation being selected, and the predicted outcome over generations — the same analytical framework you applied to the simulation.

Example	Selection pressure	Variation being selected	Predicted outcome over generations
Peppered moth (worked example)	Bird predation on moths resting on soot-darkened bark	Wing colour (light vs dark)	Frequency of the dark form increases
Antibiotic resistance			
Darwin's finches			
Sickle cell anaemia			
Trinidad guppies			

Wrap-Up & Exit Ticket (5 minutes)

Using the peppered moth as a model, explain how a change in the environment can lead to a change in allele frequency in a population over multiple generations.

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Answer Key: Natural Selection & the Peppered Moth

Part A

1(i) The process by which organisms with variations better suited to their environment are more likely to survive and reproduce, passing on their alleles. Over many generations, the frequency of the advantageous alleles in the population increases.

1(ii) All five: variation exists within the population; the variation is heritable (genetic); more offspring are produced than can survive; there is competition / a selection pressure (e.g. predation); individuals with advantageous variations survive and reproduce more (differential survival and reproduction), passing on their alleles.

2 The pale (light) moths. On soot-blackened bark they stand out and are easy to see, while dark moths are camouflaged.

Part B

B1 The light moths were harder to spot on light birch bark; the dark moths were easier to see and were eaten more.

B2

Environment	Dominant form	Why favoured
Light birch	Light (typica)	Camouflaged on pale, lichen-covered bark; less likely to be eaten
Industrial (dark bark)	Dark (carbonaria)	Camouflaged on soot-covered bark; less likely to be eaten

B3 Manual hunting is usually biased and inconsistent (e.g. clicking the most obvious moths, missing some, getting tired), so results vary between runs. The computer applies the same survival probabilities every generation, giving a smoother, more predictable change. Consistent predation gives steady directional selection; inconsistent predation gives more random fluctuation.

B4 Values from the sim. In each environment the favoured form rises from a low starting percentage to a high final percentage. The curve is steepest in the middle generations and levels off near the end. A steeper curve shows a stronger selection pressure (faster change in allele frequency).

B5 No. A small number of the less-favoured form survive by chance (predators miss some). The recessive light allele can also be carried in heterozygous dark moths, and new variation can arise by mutation, so the form persists at a low frequency.

B6 Score from the sim.

Part C

Example	Selection pressure	Variation	Predicted outcome
Antibiotic resistance	Presence of the antibiotic	Resistance to the antibiotic (from mutation)	Proportion of resistant bacteria increases
Darwin's finches	Type / size of food available (e.g. hard seeds in drought)	Beak size and shape	Beak form best suited to the food becomes more common
Sickle cell anaemia	Malaria	Sickle cell allele (heterozygotes resist malaria)	Sickle cell allele kept at a relatively high frequency in malarial regions
Trinidad guppies	Predators (and mate choice where predators are absent)	Brightness of colouration	Drab males common where predators are present; bright males where they are absent

Exit Ticket

Model answer Before the Industrial Revolution, light moths were camouflaged on pale bark, so dark moths were eaten more. Soot then darkened the bark, so light moths became more visible to birds and were eaten more. Dark moths were more likely to survive and reproduce, passing on the allele for dark colour to their offspring. Over many generations, the frequency of the dark allele in the population increased and the dark form became the most common.