**Dogs and their puppies**

The photographs show two different breeds of dog. They are both fully grown.

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| Terrier | Great Dane |

1. Two **terriers** have a puppy together. What will the puppy look like?

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| **A** | It will look like a terrier. |
| **B** | It could look like a Great Dane. |
| **C** | It could look like any breed of dog. |

1. How would you explain your answer to question 1?

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| **A** | Dogs give birth to dogs. |
| **B** | A terrier is too small to give birth to a Great Dane. |
| **C** | The puppy gets its features from its parents. |
| **D** | Terriers can only give birth to terriers. |

*Biology> Big idea BHL: Heredity and life cycles > Topic BHL1: Inheritance and the genome > Key concept BHL1.1: Heredity and genetic information*

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| **Diagnostic question** |
| **Dogs and their puppies** |

**Overview**

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| Learning focus: | Similarities and differences between family members can be explained by the passing of genetic information from one generation to the next and the effects of the interaction of organisms with their environment. |
| Observable learning outcome: | Recall that offspring inherit characteristics from each of their parents. |
| Question type: | Two-tier multiple choice |
| Key words: | heredity, reproduction |

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| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

From their everyday experiences (for example, of families and pets) students at age 11 should be aware that living organisms can reproduce to make offspring of the same kind (species resemblance), and that offspring are usually similar but not identical to their parents (body traits resemblance). These ideas are likely to have been formalised through science education before age 11 (AAAS Project 2061, 2009; Department for Education, 2013).

Lewis (2004) and others have argued that “students’ everyday conceptions [of heredity and family resemblance] are an essential starting point from which scientific understanding can be developed”, and she suggests “beginning the teaching with discussion of observed phenomena relating to heredity [to] provide opportunities for students to articulate their everyday experiences and conceptions”. Allen (2014) suggests dogs and puppies as a useful and familiar context.

Ergazaki (2015) found that most young children from the age of 5 were able to recognise that “X gives birth to X”, suggesting familiarity with the concept of parents-offspring species resemblance.

**Ways to use this question**

Students should complete the questions individually. This could be a pencil and paper exercise, or you could use the PowerPoint presentation with an electronic voting system or mini white boards.

The answers to the questions will show you whether students understand that living organisms reproduce to make offspring of the same kind (the concept of species resemblance), and that offspring inherit features from each of their parents.

*Differentiation*

If students are not likely to be familiar with dogs, or with the notion of different breeds of the same species, the dogs could be replaced with different animals.

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

1. A – It will look like a terrier.
2. C – The puppy gets its features from its parents.

**How to respond - what next?**

Students who answer question 2 with option B (“A terrier is too small to give birth to a Great Dane”) may be deducing their answer from the pictures rather than applying understanding of the inheritance of characteristics from parents. Students who select option A (“Dogs give birth to dogs”) or option D (“Terriers can only give birth to terriers”) likely understand that living organisms reproduce to make offspring of the same kind (the concept of species resemblance) as they are applying an “X gives birth to X not Y” rule; however, they have not chosen the best explanation for the puppy’s appearance in this particular context. Option A sidesteps the issue of different breeds, while option D is not strictly true as the puppy of a terrier that mated with another breed of dog would have features of both parents/breeds.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs. Responses often work best when the activities involve paired or small group discussions, which encourage social construction of new ideas through dialogue.

Researchers have used formative assessments coupled with constructivist approaches that enable students to build their own explanations of heredity, which may help to develop students’ understanding and overcome misconceptions, including the use of group discussions and challenging students to use their understanding to make predictions (e.g. Chin and Teou, 2010). If students have misunderstandings about parents-offspring resemblance, the following BEST ‘response activity’ describes a group discussion and prediction activity that could be used in follow-up to this diagnostic question:

* Response activity: What will the offspring look like?

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Images: terrier – pixabay.com/Schwarzenarzisse (361525); Great Dane – pixabay.com/alles-so-schoen-bunt-hier (1275207)

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