*Biology> Big idea BVE: Variation, adaptation and evolution > Topic BVE2: Classification*

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| **Key concept (age 11-14)** |
| **BVE2.1: Identifying and classifying organisms** |

**What’s the big idea?**

A big idea in biology is that there is a great diversity of organisms, living and extinct, with many similarities and differences between them. The diversity of organisms is the result of evolution by natural selection.

**How does this key concept develop understanding of the big idea?**

This key concept helps to develop the big idea by exploring how the similarities and differences between organisms can be used to classify them into groups.

The conceptual progression starts by checking understanding of the classification of organisms into groups according to similarities and differences in their macroscopic features. It then supports the development of familiarity with the use of keys and classification into hierarchical groups within groups, and concludes by exploring the classification of organisms according to similarities and differences at the cellular level.

**Using the progression toolkit to support student learning**

Use diagnostic questions to identify quickly where your students are in their conceptual progression. Then decide how to best focus and sequence your teaching. Use further diagnostic questions and response activities to move student understanding forwards.

**Progression toolkit: Identifying and classifying organisms**

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| **Learning focus** | Organisms can be identified and classified into hierarchical groups  based on their characteristics at the macroscopic and cellular levels. | | | | |
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| **As students’ conceptual understanding progresses they can:** | **C o n c e p t u a l p r o g r e s s I o n** | | | | |
| Classify organisms into groups according to similarities and differences in their features.  **P** | Use a key to distinguish between and identify organisms in the lab and in the field. | Use the idea that organisms can be classified hierarchically into groups within groups. | Distinguish between everyday names and scientific classifications. | Recognise that organisms can be classified into groups according to similarities and differences at the cellular level. |
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| **Diagnostic questions** | Seaside sorting | Is it a bird…? | Groups within groups | Bugs | Animal or plant? |
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| **Response**  **activities** | Classifying into groups | Build a key | Garden groups | | The blob! |

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| Key: | | | |
| **P** | Prior understanding from earlier stages of learning | **B** | Bridge to later stages of learning |

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| **Seaside sorting** | **Is it a bird…?** | **Groups within groups** | **Bugs** | **Animal or plant?** |
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| Simple multiple choice | Talking heads | Confidence grid | Drawing | Simple multiple choice |
| **Classifying into groups** | **Build a key** | **Garden groups** | **The blob!** |  |
|  |  |  |  |  |
| Discussion | Discussion | Discussion | Discussion |  |

**What’s the science story?**

There are many different kinds of organisms in the world. Keys can be used to identify organisms in the lab and in the field according to their observable characteristics. Organisms can be classified into hierarchical groups based on similarities and differences in their characteristics at the macroscopic and cellular levels.

**What does the research say?**

*The concepts of ‘animal’ and ‘plant’*

‘Animal’ and ‘plant’ are familiar concepts from everyday life, yet research suggests many school-age students struggle to define and apply the terms according to the accepted scientific definitions (Driver et al., 1994). For example, studies have found that when students were asked to give examples of animals they most often restricted their suggestions to creatures that live on land, usually with four legs, and often mammals with fur (Bell, 1981; Trowbridge and Mintzes, 1985; Patrick and Tunnicliffe, 2011). These very restrictive criteria would exclude many familiar organisms from the animal kingdom, including vertebrates such as birds and fish, and invertebrates such as worms, arachnids and insects. Notably, many students also did not recognise humans as animals, perhaps because in everyday language people are often regarded separately from wild and domesticated animals. Some cultural and religious worldviews also regard non-human animals as being less than human, uncivilised and bestial – and therefore implicitly separate (Allen, 2014).

Bell’s study produced the following results:

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| **Organism** | **Percentage of positive responses to the question “Is it an animal?”** | | | |
| **5-year-olds** | **11-year-olds** | **16-year-olds** | **Experienced primary school teachers** |
| Cow | 84 | 98 | 98 | 100 |
| Whale | 70 | 38 | 79 | Data unavailable |
| Human | 20 | 57 | 92 | 96 |
| Worm | 49 | 37 | 64 | 86 |
| Spider | 44 | 22 | 55 | 86 |
| Grass | 0 | 0 | Data unavailable | 0 |

Classic studies by Bell (1981) and Leach et al. (1992) found that school-age students also place restrictive criteria on their definitions of ‘plant’, including only organisms that have leaves, have roots, are green, and grow in the ground (or pots). Evidence suggested that some of the students regarded ‘plants’, ‘trees’, ‘flowers’, ‘weeds’, ‘vegetables’ and ‘seeds’ to be mutually exclusive categories. Bell’s study produced the following results:

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| **Organism** | **Percentage of positive responses to the question “Is it a plant?”** | | |
| **6-7 year-olds** | **10-11 year-olds** | **16-17 year-olds** |
| Grass | 74 | 71 | 95 |
| Oak tree | 39 | 62 | 100 |
| Carrot | 35 | 35 | 87 |
| Seed | 58 | 65 | 21 |

Research has suggested that students’ ability to apply the terms ‘producer’ and ‘consumer’ correctly when they come to learn about food chains and food webs may depend upon proper understanding of the concepts of ‘plant’ and ‘animal’ (Bell and Barker, 1982).

*Classifying organisms into groups*

Perhaps the most fundamental classification of things in biology is into the categories of living, dead, and never been alive; some authors have advocated exploring these classifications before building understanding of the classification of living organisms into groups (e.g. Ingram, 2011).

The study by Leach et al. (1992) found that students aged 7 could assign organisms into groups of their own choosing, but the groups were usually mutually exclusive (such that, for example, “birds” and “animals” would be separate groups) and children struggled to cope with more than two groups at a time. By age 13 most students could work with a group included within another group (e.g. “birds” as a sub-group of “animals”) when prompted, and by age 16 most students used hierarchical groups spontaneously.

Students aged 13 have been found to struggle with the meanings and application of various taxonomic classifications such as ‘insects’ and ‘flowering plants’ where there is interference from everyday use of words such as ‘bugs’ and ‘flowers’. The colloquial use of the term ‘bugs’ to describe various arthropods as well as bacteria can create or reinforce the misunderstanding that arthropods such as arachnids (e.g. spiders), myriapods (e.g. centipedes and millipedes) and crustaceans (e.g. woodlice) are insects, and that arthropods and bacteria are similar and should be classified in the same group (Trowbridge and Mintzes, 1985; Schofield et al., 1984; Shepardson, 2002; Allen, 2014). Research has also found that many students need extra help to understand and correctly apply less familiar taxonomic terms such as ‘vertebrate’ and ‘amphibian’ (Schofield et al., 1984; Braund, 1991; Allen and Choudhary, 2012). Students sometimes rely upon an organism’s habitat to classify it rather than its physical features; this can lead to misunderstandings and misclassifications, such as that penguins and turtles are amphibians rather than birds and reptiles, respectively (Allen, 2014). Several studies found that students relied upon names rather than features when classifying organisms into groups, such that – for example – jellyfish and starfish would be misclassified as fish (Ryman, 1974; Trowbridge and Mintzes, 1985).

Leach et al. (1992) reported that students of all ages were more likely to rely upon macroscopic, external characteristics visible to the unaided eye to classify organisms, and less likely to consider internal physiological or cellular characteristics.

It has been suggested that learning about classification should be coupled with experience of a wide range of living organisms, including in local habitats (Ingram, 2011).

*The concept of ‘species’*

Developing scientific understanding of variation, classification and evolution requires students to understand the concept of a species. Research into students’ understanding of the concept of a species is discussed in key concept BVE1.1 *Differences within species*, which also provides diagnostic questions and response activities to probe and develop students’ understanding.

**Guidance notes**

Perhaps the most fundamental classification of things in biology is into the categories of living, dead, and never been alive; some authors have advocated exploring these classifications before building understanding of the classification of living organisms into groups (e.g. Ingram, 2011). Key concept BCL1.1 *Living, dead and never been alive* provides diagnostic questions and response activities to probe and develop students’ understanding of these ideas.

Learning about classification inevitably involves thinking about species. Key concept BVE1.1 *Differences within species* provides diagnostic questions and response activities to probe and develop students’ understanding of the concept of ‘species’.

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