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Background information for teachers

These notes are provided to give teachers the background they may need when teaching these topics on plants. The vocabulary and words used are botanically correct. It is always advisable to keep closely to the standard terminology so that pupils have a firm foundation to build on and don't have to 'undo' their learning and vocabulary at a later stage. However, it is not intended that you pass these notes on to pupils in the form presented here.

At primary level, it is often not easy for children to appreciate that plants (even trees!) are living things, that they reproduce, require food, show sensitivity and do all the things that the more familiar animals do. However, the activities in the booklet should help children develop understanding at a suitable level and these notes aim to give teachers enough support to be able to respond to questions from curious children that are appropriate for their understanding, yet still biologically correct. The outline classification, with emphasis on plant groups, goes beyond what primary children would be expected to know, but it is important for teachers to be aware of the correct framework, so that it can be passed on to children if the discussions go further in the class. The guidance given on construction of keys should help teachers gain confidence as they do this with children in their class.

The PowerPoint 'What's in a name?' (available on the SAPS website), makes children think about why plants have names and where these names came from. With a few light-hearted examples, the PowerPoint explores the origins of some plant names and looks briefly at the history of scientific naming of plants. It also highlights ways in which plants are important to people. Use the PowerPoint as a way of introducing topics related to grouping, classification and naming of living organisms. Or you can also use it as an end of topic activity to stimulate discussion on what they have done in the different activities described in the booklet.

Characteristics of living things

In their own way, children are aware of most of these characteristics, but may find it difficult to understand them fully and express their ideas in suitable scientific terms. In particular, they often do not find it easy to apply the descriptions to plants. These notes attempt to give a basic understanding that teachers can use with children and which can be built on as children's knowledge progresses and they become more familiar with the biological processes that occur in living things. Unfortunately, a number of words are used loosely in everyday language and so there are conflicts with correct biological use. As far as possible, teachers should try to establish the correct use of words to avoid misuse at a later stage.

The mnemonic **M R S G R E N** is a useful way of remembering the seven processes that are characteristic of living things and the name helps to give children a way of remembering them. Some teachers may prefer the mnemonic 'MRS NERG' or have other ways of reminding the children about the characteristics in the 'list'.

For convenience, these notes are presented in the sequence **M R S G R E N**. For each characteristic, we make sure that suitable emphasis is given to how plants carry out the process. For most children, you are likely to deal with movement, nutrition, growth and reproduction, but with more able children you may wish to consider all of them. In discussions with children, remember that non-living organisms may show some of these characteristics, but never all of them.

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Movement

All living things move in some way. Most animals are mobile and move their whole body from place to place (e.g. by swimming, walking or flying). In plants, movements are less obvious and usually involve parts of a plant rather than the whole plant. Examples are seen in the way leaves turn towards light and roots grow downwards into the soil. Tendrils on a sugar snap pea plant rotate (or move around) until they touch something they then cling to.

Figure 12. Movement of parts of plants – these images of a sugar snap pea shows (1) the young tendril, (2) the young tendril growing in a wide circle thus increasing its chance of making contact and finally (3) making contact with a stick and coiling round it.

Respiration

In the cells of living things, respiration is the process by which energy is released from food. Oxygen is usually required to do this and carbon dioxide and water are produced. Remember, all living things carry out respiration all the time. If a living thing stops respiring it is no longer alive. Respiration should not be confused with breathing. Children should understand that, in humans (and many other animals), breathing is the way in which we get air into and out of our lungs, and so get oxygen into the body and remove carbon dioxide. (See booklet 3 *Living processes and what plants need to grow*, page 49.)

Sensitivity

Living things can react to what is happening around them. For example, humans can feel the difference between hot and cold, a person jumps in response to a loud noise and a plant shoot grows towards light (see Figure 14). In plants, response (sensitivity) is often linked to growth and movement.

Figure 13. Touch a sensitive plant and watch its leaves collapse – a sensitive plant (*Mimosa pudica*) before being touched (1) and after being touched (2).

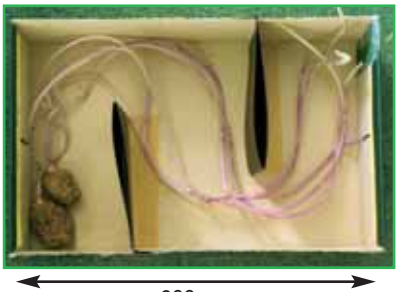

Figure 14. Response and sensitivity – the potato was left in the shoe box, with a lid on, for 12 weeks. The potato shoots grew round the two barriers in the box, towards the hole that was letting in some light. This illustrates response to light.

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Growth

Over a period of time, living things make new materials and become larger and more complex. Damaged parts of both animals and plants can also be repaired by new growth. Living things use some of the energy released from their food for growing and food materials are incorporated into the new parts or increased size.

Figure 15. Compare the sizes of this beech seedling (about 4 cm high) and the mature beech tree (up to 40 m in height). A lot of new material has contributed to the growth of this tree.

Reproduction

All living things can reproduce, making more living things like themselves. (See *Reproduction and life cycles – parts 1 and 2* for sexual reproduction in plants, and booklet 3 *Living processes and what plants need to grow*, for some information on asexual reproduction in plants.)

Excretion

All living things get rid of the waste materials produced from living processes. Both animals and plants give off carbon dioxide as a waste material from respiration. In humans, another example of an excreted material is contained in the liquid known as urine, and plants give off waste oxygen from photosynthesis. Children are likely to ask about faeces and whether this is part of excretion. You can explain that this is material that has been through the body but not actually taken part in the living processes inside cells. Biologists do not use the term 'excretion' for material contained in faeces.

Nutrition

Living things need energy for the various living processes they carry out. They get this energy from their food (see Respiration, above). Plants make their food from carbon dioxide and water, using energy from sunlight, in the process known as photosynthesis. Animals get their food by eating plants or other animals. (See also booklet 1 *Parts of a plant and their functions*, page 20, and booklet 3 *Living processes and what plants need to grow*, page 49.)

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Background information for teachers

Constructing Keys

The principles that provide the basis for construction of keys have all been covered, stage by stage, in the various activities in this booklet. Children who have progressed through a reasonable selection of these activities should have developed skills that enable them both to use and to construct a key. You (and the children) may be surprised that it does fall into place, usually quite successfully.

The liquorice allsorts activity (see page 19) is a good, simple sorting activity. The characters used (mostly shape, colour and arrangement of the different layers) are obvious, bright and appealing. Children are likely to get on with the sorting and devising questions to support their groups and have built up a simple key before they realise what they have done. It is, therefore, good as an activity to introduce constructing keys.

To construct (and use) keys with plant material, involves much more information. Children need to make more critical observations of features in the plant material. They also learn that living things often show a lot of variability and this needs to be considered when handling the information. For example, individual plants of the same species may have flowers of different colours and even single plants may have leaves with different shapes and sizes. The best characters to use for sorting and classifying are those that don't vary.

Children then need to organise the information into a form they can utilise when building up a key. Creating a 'fact file' can prove very useful as an intermediate step. Following on from this, the 'character table' is a way of collecting together information from different groups of children who will have been making their own fact files for different material. With the help of the teacher, this information can then easily be sorted into a simple key (see Figure 16). More able children can be encouraged to move on from a YES / NO approach in answer to questions to devising matched alternative descriptions for their choices when moving through the key.

We suggest the following sequence of steps for constructing a simple dichotomous key. (This is a key with two branches at each stage.)

Step 1. Describing and making a fact file

The children make careful observations and accurately describe the specimens (items / objects / species) they have been given or chosen. They should be encouraged to use suitable vocabulary and give measurements where appropriate. It is often helpful to guide children by giving them a series of questions. These questions help them collect suitable information and to create a 'fact file' for the specimens they are looking at (see Pupil Sheet on page 22 for an example).

Step 2. Creating a character table

The information collected in the fact files created by the children is collated and summarised in a 'character table' (see Pupil Sheet on page 23 for an example).

Step 3. Separating the specimens into groups

The children use the character table, and look for differences and similarities between the specimens. Using their sorting skills, they then separate the specimens into two groups. Then, taking each of these two groups in turn, the children progressively sort the specimens into smaller groups and finally to individuals.

When separating items (specimens) into groups, there is no need for these groups to be equal in size. This is often advocated by teachers as the only correct way of making a key. Equal-sized groups do lead to a shorter key and, conversely, keying off one specimen at a time gives a longer key. Some sort of compromise needs to be reached. If a specimen has a very distinctive character (say prickles) which is not shared by any of the other specimens, it is often useful to separate this specimen right at the beginning of the key. This would lead to a 'very small' group, but the rest may be more evenly balanced. We should not lose sight of the fact that, in the real world, the best (and most user-friendly) keys often have uneven-sized groups. The compromise is likely to be a mixture of these two approaches (see Figure 17 on page 34).

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For practical advice on how to create a key from the character table, see 'Making a key – using leaves'. Note that when using plant material, the 'specimens' are often (but not always) separate species. Remember – there are usually several different ways that you can construct a key, but at each stage, you focus on the special characters of a particular species, and this would enable a person to name the species you are referring to.

When the key is complete, it can be tidied up and perhaps formatted to fit an A3 or A4 page. The key can be written manually or it may be possible for children to use their IT skills. You may also be able to photocopy or scan the children's drawings, reduce them in size and use them to illustrate the key.

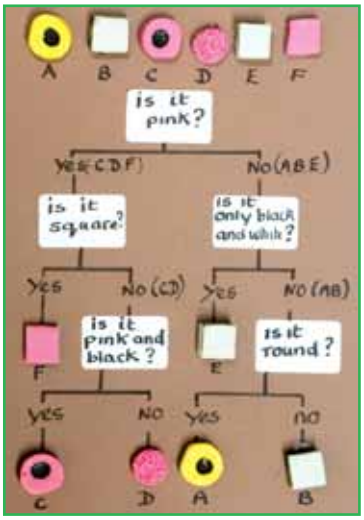

Figure 16. An example of a simple key to six liquorice allsorts.

An alternative activity for constructing a key using fruit dispersal mechanisms is available on the SAPS website. This shows an example of a key devised in this way by pupils from Ursuline Preparatory School, Wimbledon (in October 2001).

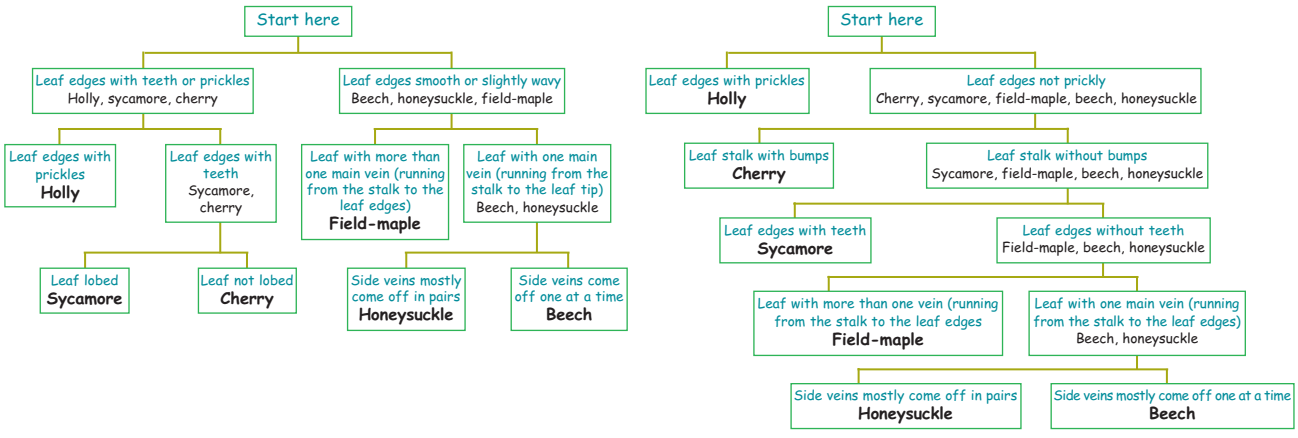

Figure 17. Leaves chosen: holly, cherry, honeysuckle, sycamore, field-maple, beech. The shorter key on the left uses equal-sized groups. The key on the right keys off one specimen at a time and results in a longer key, but sometimes this is appropriate for part of the key.

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Background information for teachers

Classification of living things

Children need to understand why living things are classified. They should also understand that a classification system is devised by people and can change, but at primary level they are not expected to know details of how living things are classified. These notes are provided for teachers to help you understand the broad classification of living things and to answer questions from children when they ask about the classification of different things (e.g. 'What is a mushroom?').

Why do we classify things?

When there are large numbers of things (like living things), our senses become overwhelmed by information. Sorting helps us to make sense of the information. We put things into categories and can see patterns, reflecting similarities and differences between them. It is at this stage we realise how important it is for the 'things' we are sorting to have names. It gets rather cumbersome to say the 'long pointed orange things with leaves on top' – it's much easier just to talk about 'carrots'.

Why does the classification of living things change?

Because of the huge number and variety of living things, it is difficult to fit them all neatly into groups. (One estimate of those so far discovered suggests the number is in the region of 1.75 million.) New living things are constantly being discovered and these may not fit into the existing groups. In addition, new ideas about how living things should be grouped are put forward by scientists and this leads to changes in the classification used.

The Five Kingdom classification

Currently, the most widely accepted classification of living things is the 'Five Kingdom' classification. The major groups, known as **kingdoms** are: Prokaryotae, Protoctista, Fungi, Plantae, Animalia. Here we give an outline of the main features of members of the plant kingdom, illustrated by examples of the five main groups of plants. A similar outline of all five kingdoms (prokaryotes, protoctista, fungi, plants and animals) is given on the SAPS website. Also on the SAPS website is a PowerPoint presentation 'What's in a name?' and it may be useful to view this alongside discussions of classification.

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Plantae

- Multicellular organisms
- Non-motile (do not move from place to place)
- Contain chlorophyll (so make food through photosynthesis – but there are a few parasitic forms)
- Cell walls contain cellulose

There are four main groups of plants:

Mosses and liverworts

A thalloid liverwort (*Marchantia* sp.)

Wall screw moss (*Tortula* sp.)

Ferns, horsetails, etc.

Male fern (*Dryopteris filix-mas*)

Horsetail (*Equisetum telmateia*)

Conifers

Male and female 'flowers' of Scots pine (*Pinus sylvestris*)

Norway spruce (*Picea abies*) with cones

Flowering plants

Wild strawberry (*Fragaria vesca*)
Flowers and fruit

Field maple (*Acer campestre*)
Flowers and leaves

Field maple (*Acer campestre*)
Fruits and leaves

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Grouping and classification

Grouping and classification is the fourth theme in a series of booklets being developed to cover the work that must be undertaken with plants as part of the Primary curriculum. In this booklet, children explore the nature of living things, find ways to group living and non-living things, and understand how we classify living things and why we give them names. Children learn to make simple keys and use them to identify certain plants. There are activities in the booklet that provide opportunities for development of skills in numeracy, IT and literacy and it includes some that are fun but at the same time reinforce pupil learning and help them to be ready to move on to the next stage.

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