

**UNIT 6: Reproduction in plants**

**Recommended Prior Knowledge:** A basic knowledge of cell structure will be helpful, but otherwise the Unit requires very little previous knowledge.

**Context:** This Unit introduces the concept of reproduction that will be developed further in Unit 7.

**Outline:** In this Unit, general features of both asexual and sexual reproduction are considered, before looking in detail at sexual reproduction in plants. Many students have preconceived ideas about plants and the more interactive activities usually stimulate the class. The Unit should therefore be covered at a time of year when suitable flowers are likely to be available. The sub-section on Growth and Development is included in this Unit. It is suggested that mitosis and meiosis are briefly dealt with here, as the concept of cell division helps with the interpretation of the distinction between asexual and sexual reproduction, although some teachers may prefer to leave this until genetics is covered or the genetics Unit 8 Inheritance and Evolution may be studied before this Unit. This Unit could also be combined with Unit 7, Reproduction in Humans.

	Learning Outcomes	Suggested Teaching Activities	Resources
III 1.1	Reproduction Asexual reproduction <ul style="list-style-type: none"> <li>Define <i>asexual reproduction</i> as the process resulting in the production of genetically identical offspring from one parent</li> <li>Describe asexual reproduction in                             <ul style="list-style-type: none"> <li>bacteria</li> <li>spore production in fungi</li> <li>tuber formation in potatoes</li> </ul> </li> </ul> Supplement <ul style="list-style-type: none"> <li>Discuss the advantages and disadvantages to a species of asexual reproduction.</li> </ul>	Ensure that students understand that 'asexual' means 'not sexual'. Asexual reproduction involves only one parent, that produces new, genetically identical organisms by mitosis.  Agar plates that have had bacterial colonies grown on them can be shown to the class if great care is taken about safety issues. Fungal spores can be easily seen on bread moulds, soft tomatoes or mushroom gills, if these are allowed to develop well past the edible stage. Unit 1, 2.1 Asexual reproduction in potatoes is often difficult for students to understand. 'Old' potatoes can be used to show the 'eyes' and to explain how these can develop and reproduce new identical tubers. Students could grow their own potato that should produce many new potatoes in about six months, flow diagrams help in understanding the asexual reproduction in potatoes.. Farmers may sell a potato with many new potatoes attached to the tuber. Students can make a table to list the main points to compare asexual and sexual reproduction. Students should appreciate that many horticulturists exploit asexual reproduction in bulbs and rhizomes .e.g. daffodils, orchids.	

	Learning Outcomes	Suggested Teaching Activities	Resources
III 3.2	<p>Mitosis</p> <ul style="list-style-type: none"> <li>Define <i>mitosis</i> as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes</li> <li>( details of the stages are <b>not</b> required)</li> <li>State the role of mitosis in                             <ul style="list-style-type: none"> <li>growth</li> <li>repair of damaged tissues</li> <li>replacement of worn out cells</li> <li>asexual reproduction.</li> </ul> </li> </ul>	<p>Students have no knowledge of genetics that will be studied in Unit 8 but they will probably be aware that the nucleus of a cell contains chromosomes that carry genes.</p> <p>Mitosis is a type of cell division that produces cells with identical chromosomes and genes to the parent cell.</p> <p>A simple series of labelled diagrams showing how chromosomes behave during mitosis, with no names of stages or details of spindles, is all that is required.</p> <p>Students should be aware that mitotic division also occurs in body cells for growth or for replacement of worn out cells throughout the organism's life.</p> <p>Mitosis is the cell division that produces identical individuals during asexual reproduction. The word 'clones' could be introduced as many students will have heard of cloning.</p>	
III 1.2	<p>Sexual reproduction.</p> <ul style="list-style-type: none"> <li>Define <i>sexual reproduction</i> as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring.</li> </ul> <p>Supplement</p> <ul style="list-style-type: none"> <li>Discuss the advantages and the disadvantages to a species of sexual reproduction</li> </ul>	<p>Sexual reproduction should be described as a process in which gametes fuse together in a process called fertilisation, producing a zygote.</p> <p>Students should understand that this need not always involve two parents: self-fertilisation, which is not uncommon in plants, is still sexual reproduction.</p> <p>Unlike asexual reproduction, sexual reproduction introduces genetic variation amongst the offspring. This is a link with Unit 8 III.3.5</p> <p>A table can be drawn up to compare asexual with sexual reproduction.</p>	
III 3.3	<p>Meiosis</p> <ul style="list-style-type: none"> <li>Define <i>meiosis</i> as a reduction division in which the chromosome number is halved from diploid to haploid (details of the stages are not required)</li> <li>State that gametes are the result of meiosis</li> </ul>	<p>Students can use coloured pipe cleaners or wool to visualise the different positions of the chromosomes during meiosis and to understand how the cell chromosome number is halved and how genetic variation can occur.</p> <p>At this stage the important concept is that gametes are haploid cells: a link with Unit , 7 1.2.2.</p>	

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	<ul style="list-style-type: none"> <li>State that meiosis results in genetic variation so that the cells produced are not all genetically identical</li> </ul>	<p>The description of meiosis should be kept as simple as possible, concentrating on its results rather than any details of the process itself.</p>	
<p><b>III</b> <b>1.2.1</b></p>	<p>Sexual reproduction in plants</p> <ul style="list-style-type: none"> <li>Identify and draw, using a hand lens if necessary                             <ul style="list-style-type: none"> <li>sepals</li> <li>petals</li> <li>stamens</li> <li>anthers</li> <li>carpels</li> <li>ovaries</li> <li>stigmas</li> </ul> </li> <li>of one locally available named insect-pollinated dicotyledenous flower</li> <li>Examine the pollen grains under a light microscope or in photomicrographs</li> <li>State the functions of the                             <ul style="list-style-type: none"> <li>sepals</li> <li>petals</li> <li>anthers</li> <li>stigmas</li> <li>ovaries</li> </ul> </li> <li>Use a hand lens to identify and describe the anthers and stigmas of one locally available named wind-pollinated flower</li> <li>Examine the pollen grains under a light microscope or in photomicrographs</li> <li>Candidates should expect to apply their understanding of the flowers they have studied to unfamiliar flowers</li> <li></li> </ul>	<p>Students should look closely at the structure of a simple, radically symmetrical, insect-pollinated flower. They can dissect it to identify the different parts, using a light microscope or a hand lens</p> <p>Annotate the diagrams to understand how the structure is adapted to its function.</p> <p>This is a good opportunity to develop or assess the practical skills of observation and recording. Students can find the terminology difficult to learn and different flowers should be available to study.</p> <p>Magnification can be calculated for the parts of the flower. Unit 1. II.3</p> <p>The functions of these flower parts are more easily understood if they are included when the structure of a flower is being drawn.</p>	<p><a href="http://www.britannica.com/EBchecked/topic/357598/dicotyledon">http://www.britannica.com/EBchecked/topic/357598/dicotyledon</a></p>

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<p>III 1.2.1</p>	<ul style="list-style-type: none"> <li>• Define <i>pollination</i> as the transfer of pollen grains from the male part of the flower (anther of stamen) to the female part of the plant (stigma)</li> </ul> <p>Supplement</p> <ul style="list-style-type: none"> <li>• Distinguish between self-pollination and cross-pollination</li> <li>• Discuss the implications to a species of self-pollination and cross-pollination</li> </ul> <p>Core</p> <ul style="list-style-type: none"> <li>• Name the agents of pollination</li> <li>• Compare the different structural adaptations of insect-pollinated and wind-pollinated flowers</li> <li>• Describe the growth of the pollen tube and its entry into the ovule followed by fertilisation (production of endosperm and details of development are <b>not</b> required)</li> </ul>	<p>Samples of insect-pollinated and wind-pollinated flowers (grasses and cereals are good examples of the latter) can be studied and compared.</p> <p>Students studying the supplement should discuss the possible outcomes of self and cross-pollination in terms of the degree of variation amongst offspring, and to compare the effects this might have on populations. This could be reviewed in Unit 8, 3.5. Ensure that the emphasis is on the species itself, not on advantages or disadvantages to farmers or gardeners who grow the plants.</p> <p>If there is time and the facilities, pollen grains can be collected from anthers of nasturtium, dead nettle or any flower with ripe stamens. A few pollen grains can be transferred to filter paper in a Petri dish and 1cm<sup>3</sup> of 0.4M dm<sup>-3</sup> sucrose solution added to the grains. The dish should be kept in the dark at room temperature and the pollen tube growth can be observed under a microscope after an hour or more.</p> <p>Fertilisation should be dealt with simply, There is no need for details of embryo sacs or the different nuclei involved. However, teachers should explain that germination involves the growth of a pollen tube from the pollen grain down the style to the ovary wall. The male nucleus (not the pollen grain) is the male gamete and fertilises an ovule. If the ovary contains many ovules, each will need to be fertilised by a different pollen nucleus. The fertilised ovule divides by mitosis, link with mitosis earlier in this Unit, to form a seed.</p>	

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III 1.2.1	<ul style="list-style-type: none"> <li>Investigate and describe the structure of a non-endospermic seed in terms of the embryo (radicle, plumule and cotyledons) and testa, protected by the fruit</li> <li>Outline the formation of a seed (limited to embryo, cotyledon, testa and role of mitosis) and fruit (produced from the ovary wall)</li> <li>State that seed and fruit dispersal by wind and by animals provides a means of colonising new areas</li> <li>Describe, using named examples, seed and fruit dispersal by wind and animals</li> </ul>	<p>The structure of seeds should be investigated practically. Soaked bean seeds are large and easy to see but need to be soaked at least two days before the lesson.</p> <p>If possible, students should be able to watch a flowering plant through all the stages from flowering through to fruit and seed development. This helps them to understand how fruits and seeds develop after fertilisation.</p> <p>A range of fruits should be looked at and the ways in which they are dispersed considered. A very common error is to confuse pollination with seed or fruit dispersal and care should be taken to avoid this.</p> <p>An experiment to measure the time taken for seeds of sycamore, lime or ash to fall can allow the students to investigate different variables of height, mass of seed, wind currents.</p> <p>At least 10 measurements for each type of seed will allow students to construct tally charts, to calculate the mean and to discuss the errors in such an investigation.</p>	
III 1.2.	<p>Growth and development</p> <ul style="list-style-type: none"> <li>Define <i>growth</i> in terms of a permanent increase in size and dry mass by an increase in cell number or cell size or both</li> <li>Define <i>development</i> in terms of increase in complexity.</li> <li>Investigate and state the environmental conditions that affect germination of seeds:                             <ul style="list-style-type: none"> <li>– requirement of water</li> <li>– oxygen</li> <li>– suitable temperature</li> </ul> </li> </ul>	<p>Mention that development includes the differentiation of cells as they become specialised to carry out different tasks.</p> <p>This is an excellent opportunity for candidates to design a simple investigation for themselves. Note that most of the seeds that are used in laboratories are derived from crop plants, and these do not normally require light for germination.</p>	