Plants for primary pupils 3

Reproduction and life cycles

Part 2: Pollination, fertilisation, fruits and seed dispersal

Science & Plants for Schools

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Bringing Environmental Understanding To All

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- Develop new resources to support plant science in schools and colleges
- Promote exciting teaching of plant science
- Interest young people in plants

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Reproduction and life cycles

Part 2: Pollination, fertilisation, fruits and seed dispersal

The activities in this booklet have been developed by SAPS (Science and Plants for Schools) in collaboration with FSC (Field Studies Council).

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Safety

Teachers using these activities with classes of Primary pupils are advised to refer to the SAPS Safety Notice on the SAPS website, and to undertake their own risk assessment where appropriate.

Further information on safety may be found from the sources listed in the SAPS Safety Notice.

Please remember...

- When working with plants, pupils and teachers should ALWAYS wash their hands after handling plants (including seeds), soils, composts, manures, equipment and other related materials.
- Plants (or parts of plants) can be poisonous, cause allergic reactions in some people or may have been treated with chemicals (such as pesticides).
- It is particularly important that pupils understand that they must NEVER eat plants found in the wild or in the school grounds, unless given instructions that they may do so.
- Children with very sensitive skin or allergies should wear gloves when handling plant material.
- Wild flowers should not be picked and it is illegal for anyone (without the permission of the landowner or occupier) to uproot any wild plant.

This resource is part of a series written to support learning with and about plants as part of the Primary Curriculum in England, Wales, Northern Ireland and Scotland. This and the other booklets in the series are also available on the SAPS website (www.saps.org.uk) and can be downloaded freely for educational purposes.

For further details about re-using these materials, please contact :

Science and Plants for Schools, Cambridge University Botanic Garden, 1 Brookside, Cambridge CB2 1JE.

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Acknowledgments

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Contents

Accompanying resources online

Looking at plant life cycles – a seasonal teaching planner

The timing of studies on plants may depend on the rest of the school curriculum but the following plan suggests the ideal times for studying different aspects of the life of plants. Some of these activities are covered in Part 1 whereas others are covered in Part 2.

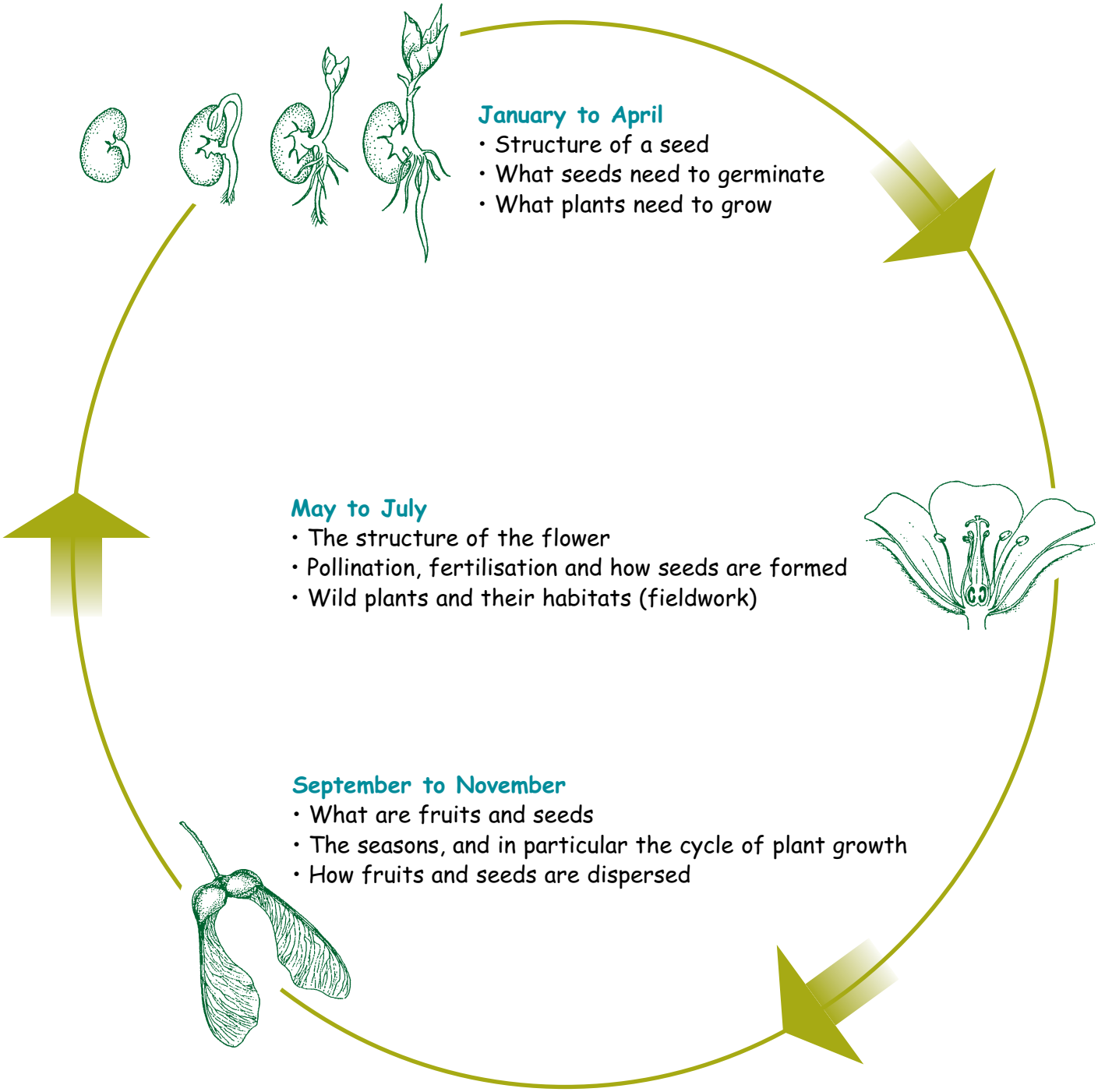


Figure 1. How to plan your plant studies in relation to the seasons – some suggestions

Introduction

This resource is part of a series written to support primary pupils learning with and about plants in England, Wales, Northern Ireland and Scotland. The activities have been developed by Science and Plants for Schools in collaboration with FSC (Field Studies Council).

The activities are being developed under a number of themes, each of which is published in a separate booklet and is also presented as website material (see SAPS website).

- **The parts of a plant and their functions**
- **Reproduction and life cycles – Part 1: Parts of a flower and Part 2: Pollination, fertilisation, fruits and seed dispersal**
- **Living processes and what plants need to grow**
- **Grouping and classification**
- **Plants in their natural environment**

Within each set of topics, you will find different types of activities. Some are based in the classroom while others involve growing plants outside (say in tubs in a school yard or in a school garden) or making observations of plants growing in the wider environment. Teachers are encouraged to let children explore links between classroom and outdoor fieldwork activities.

The activities give emphasis to the growing of plants so that children can make first-hand observations, often on their own plant, and become familiar with plants and how they grow. This is supported by a range of activities such as making models of plants, card games that reinforce learning and simple investigations that help children find out more about how plants work. You may not wish to use all the activities in a set, but you will find a good range to choose from, to suit your class and curriculum requirements.

Each topic includes a description of the activity and appropriate information for teachers. There may also be 'pupil worksheets', particularly with the activities intended for older children. An important feature in this series is the inclusion of 'Background information for teachers', written to give advice and guidance to teachers less familiar with botanical jargon or who lack confidence in their teaching on plant topics. In some cases, these notes indicate further sources of information that may be helpful to teachers, including other publications and useful websites.

The illustrations have usually been drawn from living plant material, so they are fresh, botanically accurate and show what a child is realistically likely to see. The activities are also generously supported by photographs – again many taken specially for this series.

Reproduction and life cycles

This is the second theme in the series. It is published in two separate parts: Part 1 (Parts of a flower) and Part 2 (Pollination, fertilisation, fruits and seed dispersal). There are additional online resources for each booklet. These include full-sized templates for preparation of some items required for the activities together with some further background information for teachers. The online resources for Part 2 include a PowerPoint presentation entitled 'Pollination' for use independently or as part of the learning strategy for pollination.

In Part 2, the topic includes activities that can help children become familiar with the events that occur during pollination, leading to fertilisaton. This is followed by activities linked to fruits and seed dispersal so that children have a chance to observe the different types of fruits and their means of dispersal and gain understanding of their importance in the life cycle of a plant.

The activities in Part 2 provide a natural progression from Part 1, which starts by introducing children to the basic parts of a flower and their functions, helping to build on their understanding of the parts of a plant, covered in book 1 of the series. The second booklet provides a range of activities that include dissection of a flower to see its parts – the sepals, petals, stamens, stigma, style and ovary – and how they are arranged, ways of making simple models of a plant and card games that are fun but at the same time reinforce children learning and help them to be ready to move on to the next stage.

In addition to the type of activities used in the first booklet (*Parts of a plant and their functions*), these second and third booklets offer a wider range of approaches. Children are encouraged to develop greater independence, for example, in carrying out investigative work, in devising tables to record results or using IT to draw a graph. Teachers should also be aware of opportunities offered in the different activities for development of skills in literacy, numeracy, investigative work and strategies for assessment. (See note below *Reference to literacy, numeracy, assessment and investigative skills*).

Remember you can use Curriculum Links (on the SAPS website) to find more material to give support within your teaching programme.

Reference to literacy, numeracy, assessment and investigative skills

For literacy, there are activities on listening, reading, talking, phonics and spelling. In Part 1, these are found mainly in the card games and loop cards, but also in some of the pupil sheets linked with the dissection of a flower (finding out more about flower parts). There is a word wall, with all the key terms listed. This can be enlarged and pinned on the classroom wall for the pupils to use in their work.

For numeracy, there are opportunities for work on numbers and number systems, information and data handling, problem solving and using mathematics in a relevant context. Relevant examples are included in the activities: (in Part 1) floral dissection and flower part number patterns and (in Part 2) flower colour analysis and variation in Horse-chestnut flowers.

There are also clear opportunities for both formative and summative assessment. Examples include the graphic organiser exercise on functions of flower parts and the loop card games.

Finally, many of the activities can be developed to help in the teaching of scientific investigation as there are ample opportunities for predicting, planning, observing, recording, analysing and evaluating.

Using the online resources

Converting templates into Pupil Sheets and other items

In several of the activities, templates are provided for certain items so that the teacher can make these up into the required form for use with children in the class. These items include Pupil Sheets for 'The colours of flowers' and 'The life cycle of a flowering plant – a sequencing activity based on the rapid-cycling *Brassica*'. In the booklet, reduced versions are given so that you can see at a glance what is available. Full-sized templates (A4) are available on the SAPS website.

Usually it would be appropriate to make these Pupil sheets out of lightweight card. To do this, print out the template and photocopy onto appropriately coloured card or paper. Alternatively you may be able to print directly onto the card. You can then make good durable sheets by laminating the pages and then, if needed, cut out the parts for your class.

Fruits, seeds and their dispersal

In this section, the questions on Pupil Sheet 1 can be used with Pupil Sheet 2. Pupil Sheet 2 in the supporting material provides a blank framework into which images of fruits and seeds can be pasted. Although a selection of images is included, a greater variety is available on the SAPS website at **http://www.saps.org.uk/primary/teaching-resources/223**.

The 'Pollination' PowerPoint presentation

This is provided in two formats, one with accompanying text and the second without text. This gives flexibility to teachers as to how they wish to use it with the children in their classes. It would be appropriate to use this PowerPoint presentation as an introduction to the concept of pollination and with the activity entitled 'Pollination game'. See additional notes in the booklet on pages 4 and 8. Further information for teachers relating to the pollination of the flowers shown in the presentation is given in the supporting material.

Pollination and fertilisation

Teacher Guidance

Introducing pollination and fertilisation

Pollination is the transfer of pollen, from the stamens to the stigma. The pollen is often carried by insects and other animals, but sometimes by wind or water (see Background information for teachers, page 28).

Self pollination occurs when pollen lands on the stigma of its own flower or another flower on the same plant. Cross pollination occurs when pollen is transferred to the stigma of a flower on another plant.

Once the pollen grain reaches the stigma, it produces a pollen tube, which grows down through the style to the ovary. This enables a male pollen cell to fuse with the female cell inside the ovule. This is the process known as **fertilisation**.

The following activities and games aim to help children to understand how pollination (and cross pollination) takes place. In addition, the online resources include a PowerPoint presentation entitled 'Pollination'. This 'Pollination' presentation gives children an opportunity to see a series of pictures of flowers, which are pollinated either by wind or by insects. These help explain how pollination occurs, leading to fertilisation and the formation of the seed. The range of flowers displayed demonstrate differences in general characteristics of wind and insect-pollinated flowers and it also gives examples of the close relationships that often exist between the structure of the flower and the insect that pollinates it.

Some teachers may find this presentation useful as an introduction to the topic of pollination whereas others may prefer first to take the children outside into a garden, park or field to look at wild flowers growing in a more natural environment. Some children may work through the presentation by themselves but others may need guidance from their teacher. One version of the presentation gives the series of pictures but with no text and another version gives the series of pictures with explanatory text, so there is plenty of flexibility as to how you use it. The online resources also includes background notes for teachers in support of the 'Pollination' PowerPoint presentation.

Pollination and fertilisation

Teacher Guidance

Activity 1: Demonstrating pollination using model flowers

This activity lets you demonstrate pollination in the classroom.

Preparation for the activity

1. Make up two 3D flowers (you need at least two). Follow the instructions in SAPS Student Sheet 15 (*see the SAPS website*). You can omit the ping pong balls that represent ovules but add these 'extras':
   - get some rice grains that have been coloured yellow (or something similar) to attach to the anther part of the model. These represent pollen grains
   - put double-sided sticky tape on the cap of the bottle that represents the stigma.

2. Construct some bees.

   For the **body**, you can use ***either*** a flat yellow household sponge, rolled into a tube and secured in place with black tape to represent stripes on the bee's body, ***or*** a small stuffed yellow sock, again with black tape to represent stripes and give shape to the body.

   For the **head**, use a ping pong ball and attach 2 pipe cleaners for the antennae.

   For the **legs**, use 6 pipe cleaners.

   For the **wings**, cut out 4 'wings' from clear acetate.

   Attach a small piece of double-sided sticky tape to the underneath of each bee.

The activity

Place the model flowers on opposite sides of the classroom. The bee visits the first flower and collects some pollen grains (rice) from the anther of the stamen. It then flies to the second flower where it deposits the pollen on the stigma (sticky bottle top). This demonstrates the process of pollination.

Figure 2. A SAPS model *Brassica* flower created using instructions given on the SAPS website. The final model, supported on a stick (as shown in this photograph) reaches about 1m in height

Pollination and fertilisation

Teacher Guidance

Activity 2: Demonstrating pollination using role play

This activity lets you demonstrate pollination in the classroom through role play.

You need various items to represent the different parts of a flower and you also need props for a bee. You can follow some of the suggestions given in 'Create a flower' (Part 1), but here are some ideas that are particularly useful for this activity.

Parts of flower (and bee!)	Suggested materials
sepals and petals	cut sepal and petal shapes out of card and fix to clothing or a headband
stamens	a pot (to act as a holder for the pollen grains) – use any container – e.g. ice cream tub, lemonade bottle, yoghurt pot
pollen grains	film pot lids, ping pong balls, card discs, paper balls*, fuzzy balls* - all these can have self-adhesive velcro hooks attached to them
stigma	a woolly hat on the head
bee	be imaginative! ideas could include a headband with antennae and a stripey body (made from an old T-shirt or tabard of stripey material)

* these can be purchased from a craft shop or sometimes from the local county suppliers

Figure 3. A pupil dressed up as a bee.

Preparing for the role play

You need two flowers and one bee. Adjust the number of flower parts according to the number of children in the class. For example, a flower with five sepals, five petals, five stamens and one stigma involves sixteen children.

The children dress up as the different flower parts using items as suggested in the table opposite. They are then organised into groups to form two flowers. One child dresses up as a bee.

sepal **petal** **stamen** **stigma** **bee**

The activity

The bee visits the first flower making appropriate buzzing noises and collects pollen (by removing a pollen grain from the pot). It then 'flies' to the second flower, which is waving its petals to attract the bee. The bee deposits the pollen on the stigma (by brushing the velcro hooks against the woolly hat). This can be repeated several times with the children swapping the role they play. If you wish, at the beginning of the game both flowers can be in bud, i.e. with petals, stamens and stigma crouching down and the sepals bending over them. This helps the children to understand the protective role of the sepals.

Pollination and fertilisation

Teacher Guidance

Activity 3: The pollination game

This game is suitable for children in upper primary classes. The game helps the children to reinforce their understanding of the function of the flower parts and the importance of pollination. The game can also be used to introduce the idea of cross pollination and its value.

This game needs quite a lot of space, so needs to be played outside (say on the playground or sports field), or indoors in the gym or hall. It is suitable for a class of up to about 30 children. This is not meant to be a dressing up game, so the 'flower' parts and other items should be kept simple.

Preparation for the game

The children are divided into two teams. Two children in each team are chosen as bees and the rest of the children are flowers. For the flowers, you will need the following:

- **Identity tags**. Use coloured squares or sheets of paper that can be pinned on to the children's clothes. Each flower will have a different letter written onto the piece of paper
- **Anthers** (**stamens**). Use any holder to contain the pollen grains (e.g. margarine tub, cup, cone from cardboard)
- **Pollen grains**. Various items can be used, including film pot lids, ping pong balls, paper balls, fuzzy balls, card discs. Each pollen grain has self-adhesive velcro hooks on it so that it will stick to the woolly sock (stigma). Each flower needs two or four pollen grains labelled with the same letter as the flower
- **Stigma**. Use a woolly sock over a hand for the pollen grains to stick on.

In addition you will need:

1. **Hives**. You need one for each team. You can make a hive out of a box, with rows of 'cells' inside (e.g. made out of the inside of kitchen paper rolls, paper holders or egg trays)
2. **Worker bees**. These can be identified easily by wearing a baseball cap and a badge (or they can wear a stripey T-shirt and some sort of head band and 'antennae').
3. A whistle and stop watch.

Each team of flowers lives in its own flower bed. Mark out the flower beds with ropes or tapes (15 m x 10 m is a good size for each bed, but the actual size depends on how much space is available). Place each hive with its two worker bees at an appropriate distance from one of the flower beds, say 10 m.

The flowers scatter and put down roots (in their own flower bed). Once rooted, these flowers cannot move their feet around any more. The bees stand beside the hive.

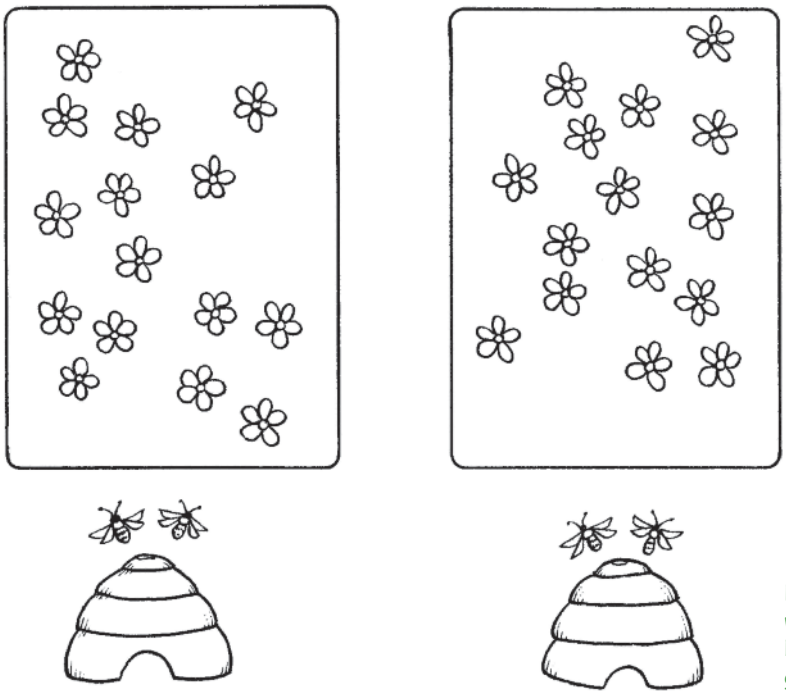


Figure 4. Flower beds with flowers and hives for pollination game

Playing the game

Blow the whistle to start the game:

- the worker bees leave the hive and run to the flower bed to collect pollen from the flowers
- as each worker bee visits a flower it collects two pollen grains. It must then return to the hive and deposit one pollen grain in the hive before visiting another flower
- at the next flower, the bee deposits the second pollen grain on the woolly sock (stigma), and then collects two more pollen grains
- as above, the bee takes one of these pollen grains to the hive and the second on to another flower

- this game could be noisy so the flowers are not allowed to move their feet or make any noise, but they can choose any other way they like to attract the bees (such as swaying their arms) if they need to be visited
- once they have been visited and all their pollen taken, suggest that the flower stands completely still and makes no more attempts to attract the bees (otherwise they will be wasting the bee's effort)
- the bees can communicate with each other only by buzzing and waggling their bottoms, trying to tell the other bee(s) which flower(s) still need visiting.

The bees continue their activities (collecting and depositing pollen) until the whistle blows to stop – three minutes is probably a suitable time.

Each team then counts the number of pollen grains that have been transferred:

- to the hive for the bees
- onto the sock – these show that pollination has taken place (i.e. pollen has been transferred from anther to stigma).

The team with the highest total score is the winner.

Now play the game again, several times, but swap the children around so that more than two have a turn at playing the bees.

Introducing the idea of cross pollination

When the children are sure what pollination is, the game can be played again to introduce the idea of cross pollination.

This time the letters on the flowers and the pollen grains are used. You should explain that the flowers are all from the same kind of plant, but the letters indicate the different plants that the pollen came from.

When checking the pollen grains that have landed on the stigmas (woolly socks), look at the letter on each pollen grain. If any have the same letter as the flower, this shows that they came originally from that flower so they have been 'self-pollinated'. If pollen grains on the sock have a different letter from the flower on which they have landed, it shows that they have come from one of the other flowers. These have been 'cross-pollinated'. Explain that cross pollination is better than self pollination and therefore the score for these pollen grains is doubled. Check that children understand that, after pollination, fertilisation takes place which leads to the production of seeds.

Pollination and fertilisation

Teacher Guidance

Activity 4: The colours of flowers

This simple exercise concentrates on the role of the petals in attracting insects. The activity also provides an opportunity to go outside to do some fieldwork and learn the names of some wild flowers. Children can then make links between their outdoor and classroom activities. An alternative version is given for those who cannot find a suitable range of flowers close to the school.

At this stage it would be particularly useful to make a link to the PowerPoint presentation 'Pollination' included in the online resources and let the children see the pictures of different flowers. You can refer to the description of this presentation, and how to use it, given on page 4 of this booklet. More useful supporting information is given in the publication 'Exploring colour in the environment' (*see reference below).*

If possible, record only **wild flowers**. If you look at *wild* flowers in the UK, you will probably find only a few bright red flowers. You can prompt children to ask questions about this and then you can tell them that many insects do not see red well, so this is not a good colour for attracting insects. However, if you use *garden* flowers, you may find that more of these have bright red flowers. Many cultivated flowers have come from abroad where sometimes pollination can be by birds, and birds are able to see red well. Cultivated flowers have often had unusual colours bred into them to please gardeners.

The activity

Let the children think about ways in which the petals might help to attract insects. Encourage them to consider the following:

- colour
- size
- shape
- production of nectar
- scent
- nectar guides

Then the children can make some predictions. One possible prediction is that 'most flowers are brightly coloured'.

This activity is based on fieldwork. Take the children outside on a short walk and ask them to record the colours and names (where possible) of the wild flowers that they see.

To help with the recording, give younger children square coloured tokens, made of card. They then write the flower names on the appropriate coloured token. Older children can fill in their own chart (see reduced sized version of the Pupil Sheet on page 12). A full-sized template of the Pupil Sheet is provided on the SAPS website. Instructions for preparing a suitable sheet from the template are given on page 3 of this booklet. Alternatively, children can make their own chart, using paint, colours or coloured paper. Make sure you keep close to the range of colours shown in the booklet (or on the website).

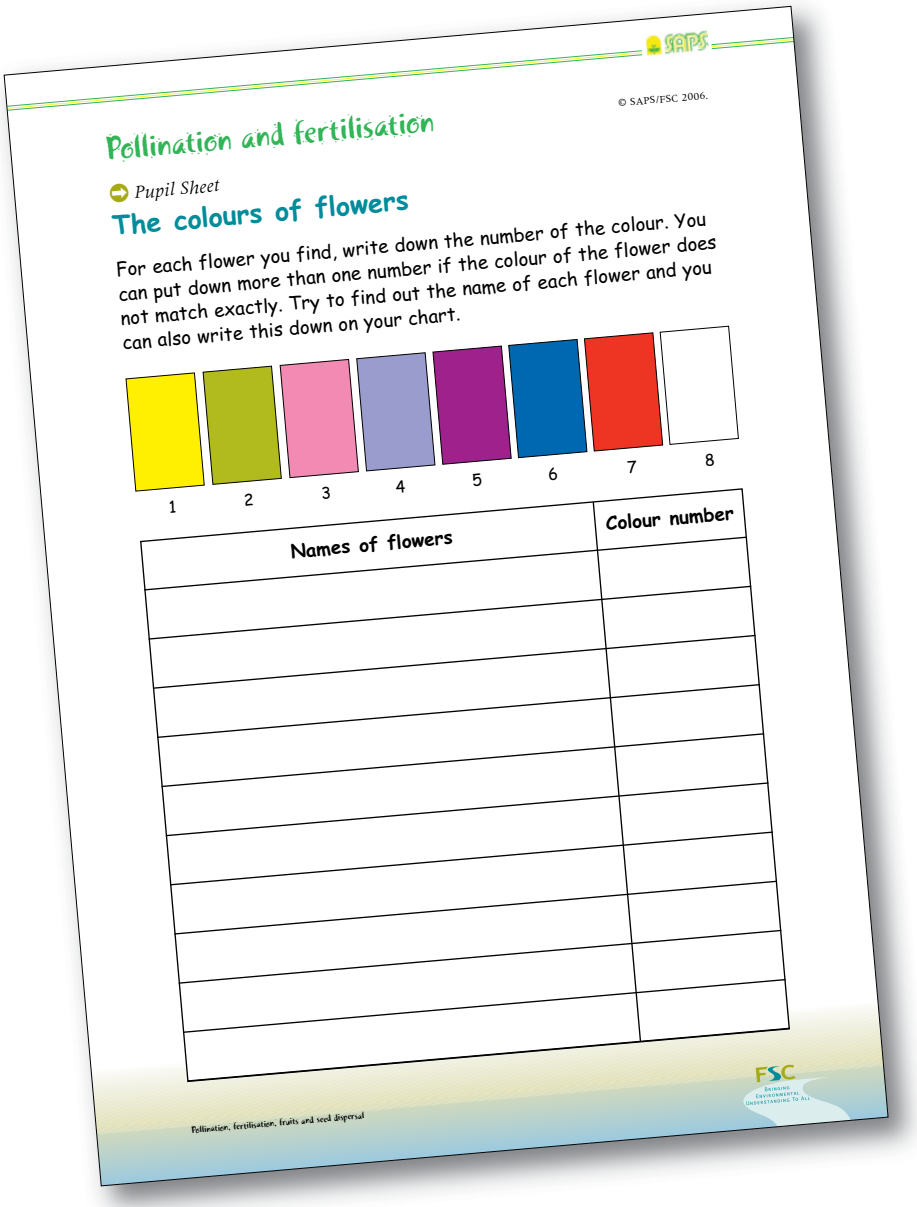
On return to the classroom

The information gathered can be presented in a graph to show the frequency of the different flower colours that they saw.

- **Coloured tokens**. Use these to form a simple block graph showing how many flowers of each colour were found
- **From the chart**. The information from the different charts can be collected together and children can draw their own graph or use their IT skills to generate a computer graph.

Discussion

Most flowers that they find will be brightly coloured. The children may not think that white is a bright colour, but point out that it stands out well on a dark background. With older children you can discuss the possible presence of ultra-violet signals, which people cannot see but insects can. Small green flowers are often wind-pollinated.



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Pollination and fertilisation

Pupil Sheet

The colours of flowers

For each flower you find, write down the number of the colour. You can put down more than one number if the colour of the flower does not match exactly. Try to find out the name of each flower and you can also write this down on your chart.

1 2 3 4 5 6 7 8

Names of flowers	Colour number

Pollination, fertilisation, fruits and seed dispersal

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Figure 5. Reduced size version of Pupil Sheet for recording colours of flowers. A full-sized template is provided on the SAPS website.

Alternative version (in the classroom)

If it is impossible to go for a walk, you can find other ways to do this activity with the children by using pictures. You may have posters of wild flowers that you could use for pictures of flowers. Another useful source of pictures of wild flowers is one of the FSC fold-out charts (see reference list below).

Further information

For help with identification of wild flowers, you will find it useful to look at the FSC fold-out charts, obtainable from FSC Publications.

FSC Publications, Unit C1, Stafford Park 15, Telford TF3 3BB.
Telephone: 0845 345 4072
e-mail: publications@field-studies-council.org
www.field-studies-council.org

Farley *et al. Playing field plants* (2005). OP97.

Bebbington A and Bebbington J *Guide to grassland plants 2 (chalk and limestone)* (2005). OP95.

Gulliver *et al. Grassland plants 1* (2002). OP68.

Gulliver *et al. Woodland plants* (1998). OP50.

More information about colour in the environment is given in
Bebbington A and Bebbington J *Exploring colour in the environment* (OP63) and the accompanying *Teacher's Guide* (OP101).

Pollination and fertilisation

Teacher Guidance

Activity 5: Exploring Horse-chestnut flowers

Figure 6. Horse-chestnut tree in full flower

Figure 7. The inflorescences of Horse-chestnut are known as 'candles'

Buds of Horse-chestnut (*Aesculus hippocastanum*) are familiar to many children and can be dissected to show their structure (see the SAPS website). Even at the bud stage, you can clearly see developing leaves and flowers. By mid-May to early June, Horse-chestnut trees are normally in full flower. It is a spectacular sight with many thousands of flowers in large pyramidal inflorescences – often known as 'candles'.

Horse-chestnut flowers show variation in different ways. Here are some of the ways that Horse-chestnut flowers can vary:

- the number of floral parts in each flower
- many of the flowers function as 'male only' flowers and the female parts (gynoecium) do not develop
- 'blotches' on the petals vary in colour, ranging from salmon pink to a pinkish-red (carmine). It is known that many insect-pollinated flowers change their colour when they have been pollinated or they run out of pollen or other insect attractants so that they no longer attract insects.

This activity is suitable for upper primary. Children can use their knowledge of flower structure and function and investigate aspects of pollination, make some predictions, collect data and try to find reasons for some of their observations. Children taking part in these activities are likely to become much more aware of the relationship between the structure, colour and movement of different floral parts as well as the behaviour of visiting insects.

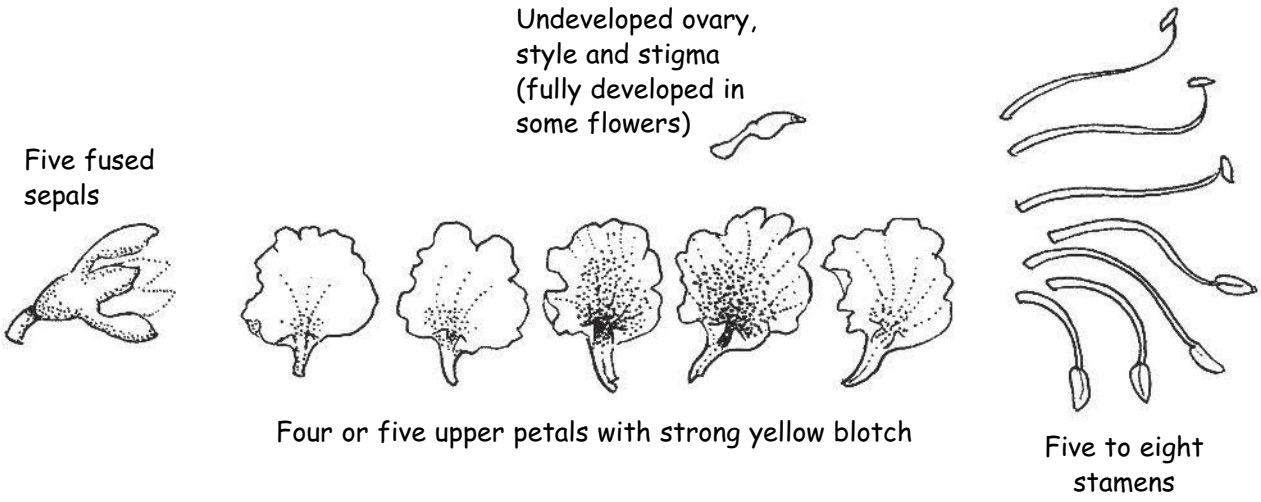


Figure 8a. Dissected 'male' flower of Horse-chestnut, showing its parts

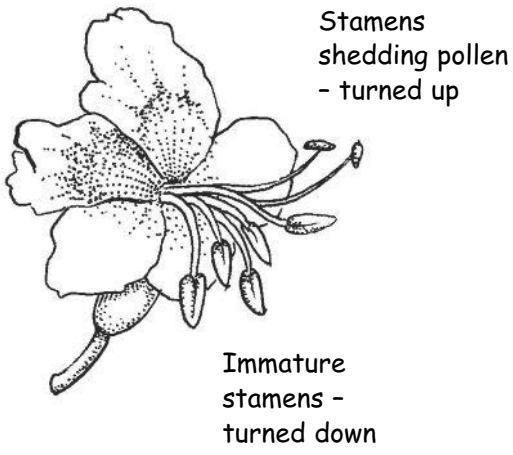


Figure 8b. Horse-chestnut flower with yellow blotches

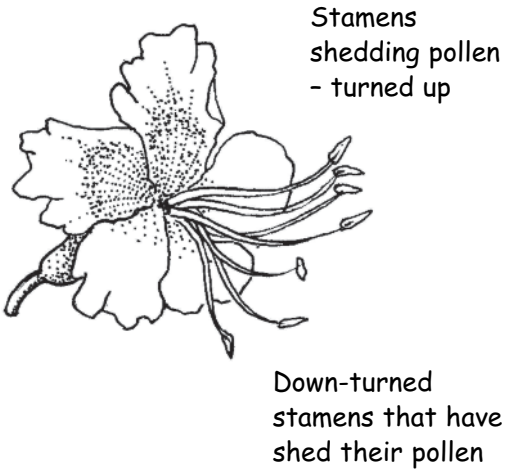


Figure 8c. Horse-chestnut flower with red blotches

The activity

- Give children a single Horse-chestnut flower so that they can work out its structure. First get them to dissect a flower and lay out the parts (as described in 'Dissecting a flower' – Part 1, page 5).
- Then they can look at different flowers. Have a discussion with the children about what they have seen. Encourage them to see the variation in colour and let them try to suggest reasons for this.
- They can look again at their 'candle', and note also the position of the stamens (whether turning upwards or turning downwards) and see how this relates to the colour of the flowers.
- From their observations, let the children make a prediction, say linking the colour of the flower and the position of the stamens or whether pollination has taken place. Examples of a suitable prediction could be: 'the red flowers will have fewer turned-down stamens than the yellow ones', or 'red flowers would have no pollen left'.

- Let the children plan an investigation that could be used to test their predictions. For example, they might record the colour of the flower blotches and the number of stamens turned up and the number turned down. Or they might use a cotton wool bud to touch flowers with different coloured blotches and see whether or not they collect pollen.
- Encourage the children to devise tables in which they can record their results and think about how many flowers they need to examine. Also make sure they record and discuss any difficulties that they find in trying to make their observations.

  Here are some possible headings for tables:

  > colour of blotches on the petals + number of flowers with each colour
  > colour of blotches on the petals + number of stamens pointing up + number of stamens pointing down
  > colour of blotch + cotton wool bud with pollen + cotton wool bud with no pollen
- Can they see any pattern? Does it fit with their prediction?

Their discussions are likely to raise yet more questions. Here are some suggestions that can be used to stimulate more thoughts and investigations, or may be raised by the children themselves.

> Does the number of red flowers per candle increase with time?
> Do bees visit yellow flowers more often than red ones?
> How long does it take for a single flower to change colour?
> Is the change in colour affected by the length of time the flower has been exposed to sunlight? Or is some other factor involved, such as the beginning of the shedding of pollen, or a visit by an insect?

Pollination and fertilisation

Teacher Guidance

Activity 6: Pollination and fertilisation challenge

This activity presents the designing of a poster as a 'challenge', providing a way of helping children understand pollination and fertilisation. At the same time, skills being developed include collaborative working and presentation skills (oral and written) as well as opportunities for assessment.

Key question: How do plants reproduce themselves?

The setting

The local Botanic Gardens have decided to produce new materials for primary school children interested in learning about flowering plants. They have asked schools in the area to help design a poster to show how plants reproduce themselves.

The challenge

Divide the class into groups of three or four. Ask each group to design a poster that shows how plants reproduce themselves. To help your groups complete the task, first of all get them to think and talk about what they have already learned about pollination and fertilisation. You can encourage them to use books, leaflets and suitable websites as sources of information. Then ask them to design the poster.

Once the posters have been completed, display them in the classroom. Then ask each group in turn to explain their poster to the rest of the class. They should be prepared to answer questions about their work.

Criteria for a good poster:

- should convey information about pollination **and** fertilisation – in pictures, diagrams, words and phrases
- information should be well organised and neatly presented
- content of the poster should be appropriate for children of their own age.

Fruits, seeds and their dispersal

Teacher Guidance

Introducing fruits, seeds and their dispersal

After fertilisation, seeds will form. It is important for the seeds to be spread (dispersed) away from each other and from the parent plant. This helps to avoid overcrowding and the competition for light, water and mineral salts that would result. Dispersal also enables species to take advantage of new opportunities and to survive if conditions for the parent plant become unsuitable.

Plants have a variety of ways in which they disperse their seeds, or the fruits containing the seeds. Four main groups of dispersal mechanisms can be recognised: animal, wind, water and self-dispersal. The size, shape and colour of the fruit and seed, together with other features, reflect the method of dispersal.

The activities described here encourage children to understand how fruits and seeds are adapted to being dispersed in different ways. Then, when the seed starts to germinate, we can see how this completes the life cycle of the plant. You can link this stage to the life cycle activities (*The life cycle of a flowering plant – a sequencing activity based on the rapid-cycling* Brassica) given on page 26.

Fruits, seeds and their dispersal

Teacher Guidance

Activity 1: The sultana game

This is a game that can be played with quite young children to introduce the concept of seed dispersal. In particular, the game can get them to think about the way in which large seeds, such as hazel nuts and conkers, are dispersed by small mammals.

A number of small mammals habitually store food for the winter. Stores of food, if they are not found or revisited, are potentially able to germinate and grow into new plants.

We are not sure where the idea came from for this game. Originally it was played with peanuts, but this version has been adapted and uses sultanas to avoid possible problems with children who suffer from nut allergies. Sultanas are also readily biodegradable!

The activity

Give each child a sultana. Tell them they are squirrels and that the sultana is part of their winter store of food. Define an area and tell them they can hide their sultana somewhere in this area.

After hiding their sultanas, take the children to another area and let them carry on with another activity for at least half an hour (longer if possible). Then return to the area and give the children five minutes to find their sultana. Several will not be able to find them.

Ask the children why, if animals can't find their store of seeds, this might be important to a plant.

Children should be warned not to eat the sultanas after they have been hidden. It is a good idea to have a bag of clean sultanas as a reward for 'busy squirrels'!

This activity has been adapted from the version on the SAPS website.

Fruits, seeds and their dispersal

Teacher Guidance

Activity 2: Wild-oat and its 'performing' seeds

Figure 9. Wild-oats growing along edge of field

Figure 10. The fruiting head of Wild-oat

Seeds of the Wild-oat make an excellent introduction to a lesson on fruit and seed dispersal.

Place a small heap of the seeds in a tray and spray them with water. The seeds begin to tumble over one another and move around the dish – a sight that usually leads to lots of excited comments and questions. Ask the children to look carefully and describe what is happening. Then ask them why they think having seeds that can move might be important to a plant.

What is happening

One of the bracts enclosing the seed of this grass has a long bristle (awn) attached to it. When the seed is ripe this bristle develops a right angled bend and twists as a result of uneven thickening in the cell walls. On the ground, if the bristle becomes wet it will untwist and straighten making the seed roll over. As it dries out again the bristle bends and twists once more. As moisture levels in the air change these hygroscopic movements make the oat seeds wriggle around until they fall into a crack in the soil.

The spiral twisting movements then drill the seed into the ground. Hairs at the base of the seed prevent it from being pulled out when the direction of twisting changes. Try putting a few in a pot of soil and watching them plant themselves.

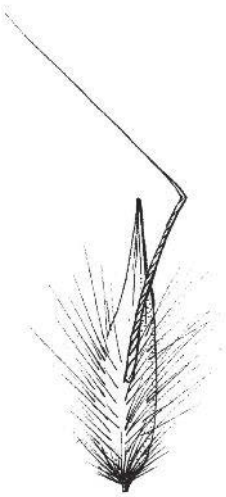


Figure 11.
A single one-seeded fruit of Wild-oat

Strictly speaking, in grasses the fruit wall is united to the seed. The seed is therefore in reality a one-seeded fruit. It is probably not necessary to pass this information on to the children.

Where to find Wild-oats

The Wild-oat can be found growing as a weed around the edge of agricultural crops in July and August in the UK. You are likely to find either the common Wild-oat (*Avena fatua*) or Winter Wild-oat (*Avena sterilis*) – both work equally well.

Once the seeds have been collected and dried they will keep for several years and can be used over and over again for demonstration. They should be carefully dried between use by placing them in a warm dry place (an airing cupboard is ideal) for 48 hours. Wild-oat is a serious agricultural pest and it is very important that seeds are not allowed to 'escape' into the wild. When you have finished with them they are best burnt. They may find their way onto farm land through the waste disposal system.

Other seeds with similar properties include *Erodium gruinum* and *Erodium cicutarium*, available from specialist seed suppliers such as Plant World Seeds. Videos showing these seeds in action can be found on YouTube and similar video sites.

Further activities

1. For more ideas for using oats in your teaching, see *Student Sheet 11* on the SAPS website.

2. Use other plants with seeds that have similar mechanisms, e.g. the Common Stork's-bill.

Fruits, seeds and their dispersal

Teacher Guidance

Activity 3: Finding out about how fruits and seeds are dispersed

This activity can be used to help children link special characteristics of fruits and seeds with the way in which they are dispersed.

It is essential right at the beginning of the exercise to stress that fruits which birds and other animals enjoy eating may be very poisonous to humans. Nothing must be eaten without the permission of the adult in charge.

The activity

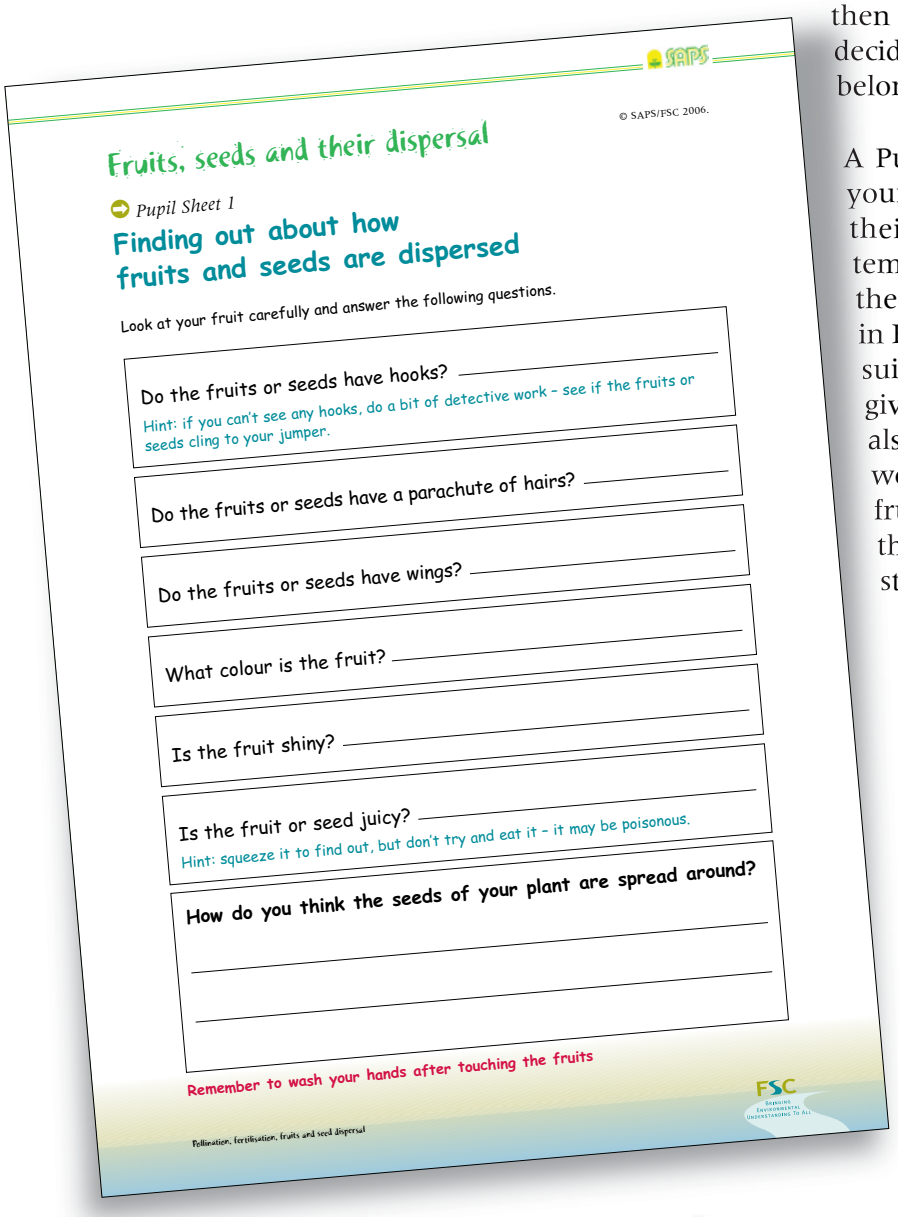
As preparation for the activity, collect common local fruits, with a different one for each group and preferably each with a different dispersal mechanism. Spread out the fruits on chairs or stools in the garden or classroom. The FSC fold-out chart *A guide to fruits and seed dispersal* (OP71) can be used to help with identification. See 'Further activities' on page 24.

Divide the children into small groups. Give each group a drawing of one of the fruits and ask the children to match the drawing with the correct fruit. There are four drawings included on the online resources that can be used as examples. Let the group examine the fruit carefully and, with help, fill in the questionnaire given in the pupil sheet. Each group tries to decide how the fruit or seed might be spread around.

Ask each group to explain how they think their fruit is dispersed, picking out important features – for example, the wind dispersed fruits are very tiny or have wings or parachutes. Let each group of children choose a name relevant to the dispersal mechanism of their fruit (e.g. the pepperpots), and which helps them remember the important features.

Take the children for a short walk and let them look for more fruits and seeds. If there are fields and woods close to the school, this is ideal, but there may be suitable places in the school grounds or in a nearby park. For each fruit or seed they find let them look at its characteristics, then with help from the teacher they can decide which dispersal group it should belong to.

A Pupil Sheet gives a set of questions for your children to answer when looking at their fruits and seeds. A full-sized template of the Pupil Sheet is provided on the SAPS website (with a reduced version in Figure 12). Instructions for preparing a suitable sheet from the template are given on page 3 of this booklet. There is also a selection of pictures on the SAPS website illustrating different methods of fruit and seed dispersal. You can use these as examples to get your children started with this activity.



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Fruits, seeds and their dispersal

Pupil Sheet 1

Finding out about how fruits and seeds are dispersed

Look at your fruit carefully and answer the following questions.

Do the fruits or seeds have hooks? _____

Hint: if you can't see any hooks, do a bit of detective work – see if the fruits or seeds cling to your jumper.

Do the fruits or seeds have a parachute of hairs? _____

Do the fruits or seeds have wings? _____

What colour is the fruit? _____

Is the fruit shiny? _____

Is the fruit or seed juicy? _____

Hint: squeeze it to find out, but don't try and eat it – it may be poisonous.

How do you think the seeds of your plant are spread around?

_____

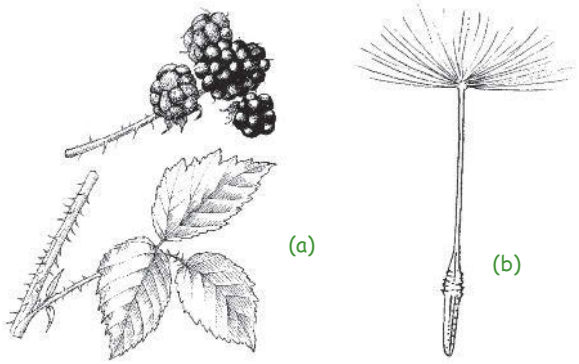
_____

Remember to wash your hands after touching the fruits

Pollination, fertilisation, fruits and seed dispersal

FSC Bringing Environmental Understanding To All

Figure 12. Reduced size version of Pupil Sheet for recording details about fruits and seeds. A full-sized template is provided on the SAPS website.



(a)

(b)

Figure 13. Examples of fruits and seeds: (a) Blackberry; (b) Dandelion.

Further activities

1. The FSC fold-out chart – *A guide to fruits and seed dispersal* (OP71) is a useful resource to support this activity. See the SAPS website for suggestions as to how to use it. All the illustrations on the FSC fruits and seeds chart are available on the SAPS website and can easily be made into more worksheets that you can use with your children.

2. In the autumn, adapt the activity 'The colours of flowers' (*see page 11*) to look at colours of fruits and seeds.

3. Construct and use a key to dispersal mechanisms – this activity helps to highlight the characteristics of fruits and seeds with different dispersal mechanisms. It is particularly suitable for upper primary pupils or for use as an extension activity. Guidance on how to construct such a key is available on the SAPS website and is also included in booklet 5 of this series (*Grouping and classification*).

Fruits, seeds and their dispersal

Teacher Guidance

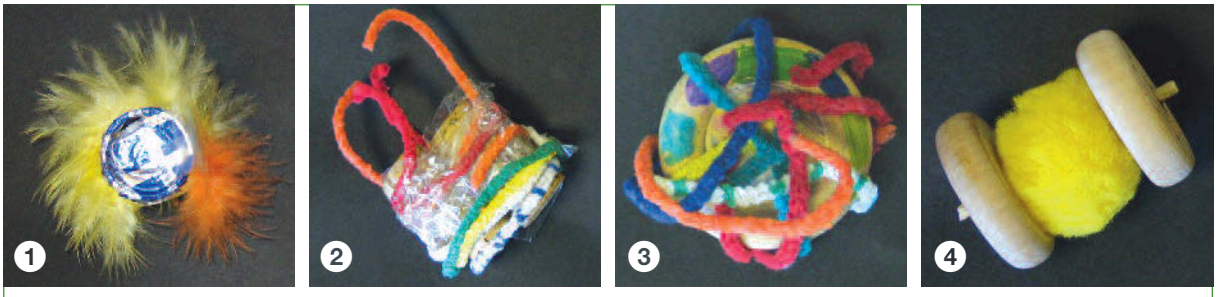
Activity 4: Design a seed

This activity involves designing a seed, which has come from a newly discovered plant. It stimulates discussion on how the seeds are dispersed as well as providing a link to the topic of germinating and growing seeds (*see booklet 4 – Living processes and what plants need to grow*). It requires some creative thinking and also gives opportunities for developing literacy and presentation skills.

The activity

Suggest to the children that they are going on an expedition to look for new plants and bring back some seeds from these plants.

- Ask the children to make a drawing of the plant they discover and give its name. (You can let them discuss how scientists name new plants when they are found.)
- Review the different ways in which plants can disperse their seeds. Then ask the children to make a magnified drawing of a seed from their plant and explain how they think it is dispersed.
- From their design, let them make an enlarged version of their seed, using junk materials.



1. Seed from the Butterfly Eating Blob Plant. The seed is dispersed by the explosion of the seed pod and it falls gently to the ground because of its feathers. Then legs pop out and it walks away.

2. Seed from the Target Plant. The seed has lots of hooks so it can attach itself to animals.

3. Seed from the Leaf Poison Plant. This seed is an attractive colour to animals who will eat it. It will then pass through the animal's body. The outside of the seed cracks open so that it can start growing when it touches the ground.

4. Seed from the Truncheranium plant. This seed has wheels so when it falls from the parent plant it rolls away and begins to germinate.

Figure 14. Some seeds created by children (in Year 4 at the Cavendish School). They collected their seeds on an 'expedition', from newly discovered plants, and then gave descriptions as to how the seeds would be dispersed.

Teacher Guidance

The life cycle of a flowering plant

A sequencing activity based on the rapid-cycling *Brassica*

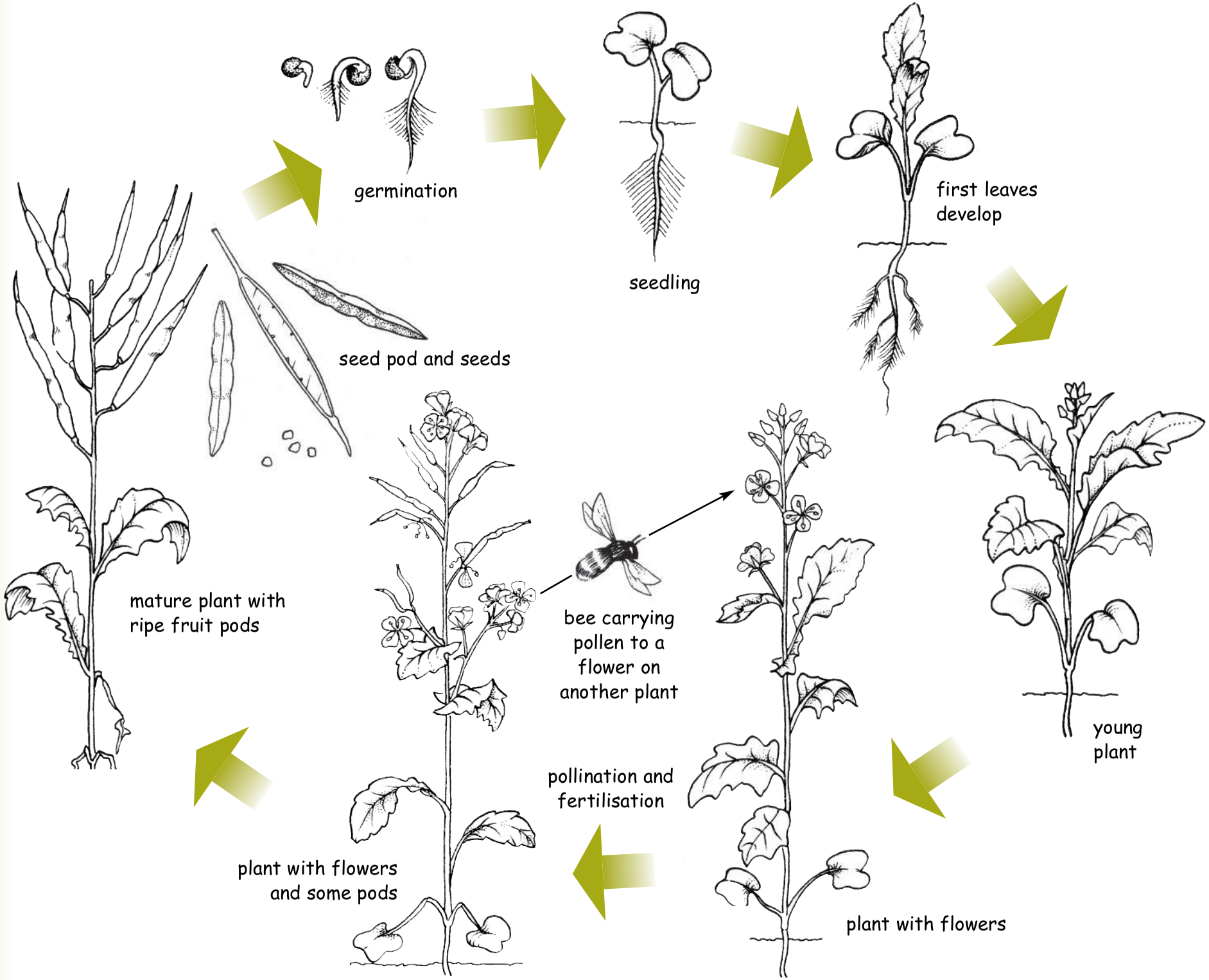
The typical life cycle of a flowering plant, using the rapid-cycling *Brassica* as an example, is summarised in Figure 15. More information about how children can grow this plant in the classroom and observe the life cycle for themselves is given in booklet 4 of this series (*Living processes and what plants need to grow*).

Here we show how this life cycle can be adapted and used as a sequencing activity. This will help children demonstrate their understanding of the progression through the life cycle and reinforce their learning of the different stages covered in these booklets (Parts 1 and 2).

The online resources include a Pupil Sheet with an outline of this life cycle, with text but without pictures. This template can be printed, enlarged and laminated (see page 3 of this booklet) for use in this activity. The online resources also include templates for the drawings of the different stages of the rapid-cycling *Brassica*, from seed through to a mature plant with seed pods. You can prepare these and cut them out to make cards so that each child or group has a complete set of pictures. It can alternatively be used as an interactive whiteboard resource.

The children are then required to place the picture cards in the correct sequence on the outline of the life cycle.

Figure 15. Summary of the life cycle of the rapid-cycling Brassica for use as a sequencing activity. Templates for the life cycle and drawings of the different stages are available on the SAPS website.



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.

Reproduction and life cycles – the flower, fruits and seeds

At primary level, when learning about reproduction, the children are first expected to know about the parts of a flower and their role in the life cycle of flowering plants. These topics are covered in Part 1. They should then learn how the events taking place at pollination lead to seed formation and how the seeds are dispersed and these topics are covered in Part 2. For activities relating to the topic of germination, teachers are referred to the third theme in this series: *Living processes and what plants need to grow*.

A summary of the whole life cycle of a flowering plant (using rapid-cycling brassicas as an example) is given in Part 2. A simpler form of the life cycle (of a sugar snap pea) is given in the first booklet (*Parts of a plant and their functions*), on page 10.

The activities in Part 1 and Part 2 should give children opportunities to become familiar with all the required vocabulary for the parts of the flower and also to understand the processes occurring at pollination leading to fertilisation. A number of activities in Part 2 introduce children to the concept of dispersal of fruits and their seeds.

In Part 2, these notes give you some extra information about events relating to the formation of seeds and fruits, and a range of methods by which fruits and their seeds are dispersed. You can find an extensive range of drawings and photographs on the SAPS website.

Pollination and fertilisation

Pollination

Pollination is the transfer of pollen from the stamens to the stigma. The pollen is often carried by insects and other animals, but sometimes by wind or water.

Self pollination occurs when pollen lands on the stigma of its own flower or another flower on the same plant. **Cross pollination** occurs when pollen is transferred to the stigma of a flower on another plant of the same species.

Because of the way that pollen grains are formed, within a single plant the pollen grains may be (genetically) slightly different from each other. Similarly the ovules within the same plant may be genetically slightly different from each other. Thus, even self pollination can result in some variation in the offspring. Cross pollination, however, because the genetic material comes from two different parents, results in greater variation and is, therefore, considered to be advantageous to the plant. In many plants, the design and form of the flower promotes cross pollination.

Fertilisation

When the pollen grain lands on the stigma it receives a chemical signal from the stigma. A tube from the pollen grain grows down the style into the ovary and into one of the ovules. Here fusion takes place between genetic material in the male and female cells. After fertilisation, the ovule develops into a seed. When conditions are appropriate, the seed begins to grow into a new plant (**germination**). For more information on germination, see 'Background information for teachers' in the next booklet: *Living processes and what plants need to grow*.

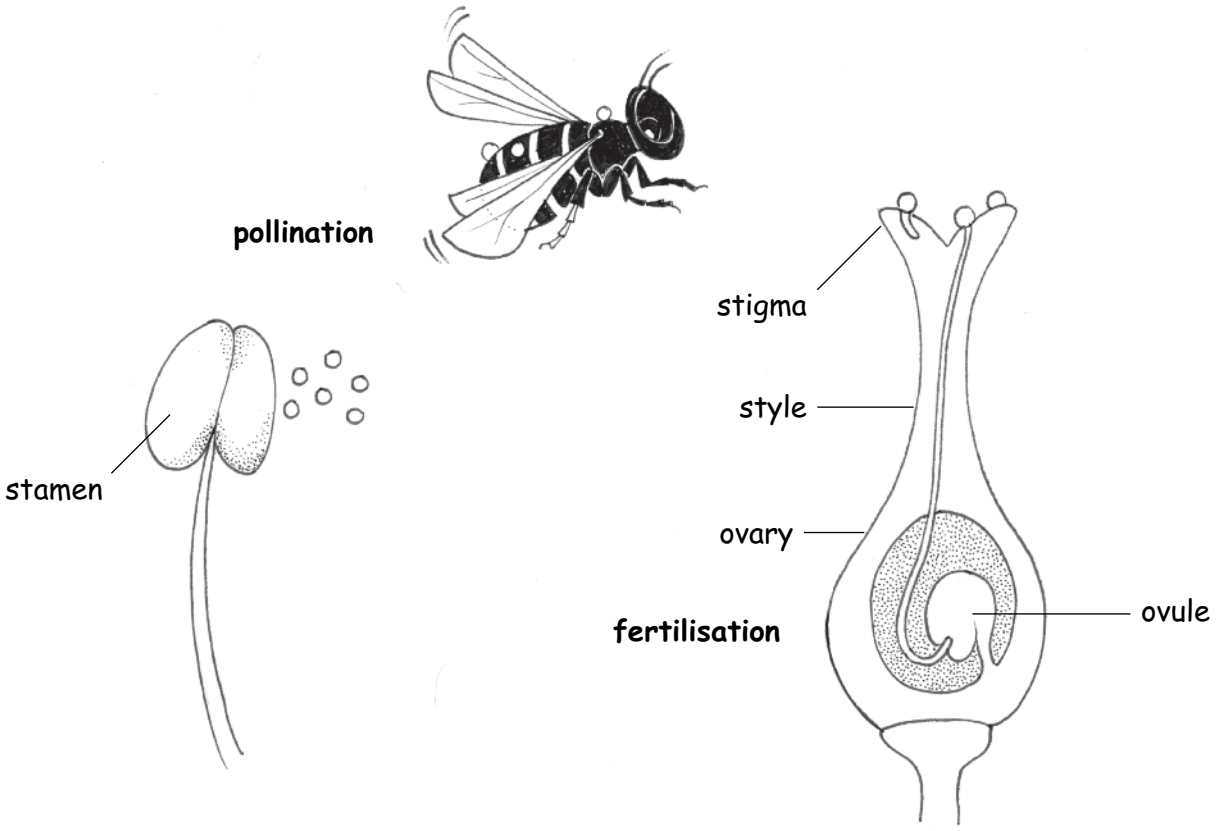


Figure 16. Showing how pollination and fertilisation can take place

Fruits, seeds and their dispersal

Formation of the fruit

After fertilisation, the ovule develops into the seed. The seed or seeds, surrounded by the ovary wall develop into the fruit (as shown in the pea). In some plants, other parts of the flower may also help to form the fruit. Good examples are the dandelion and the apple. In the dandelion, the parachute is formed from the sepals. In the apple the fleshy part is the top of the flower stalk. The fleshy part encloses the ovary and its seeds, which form the core.

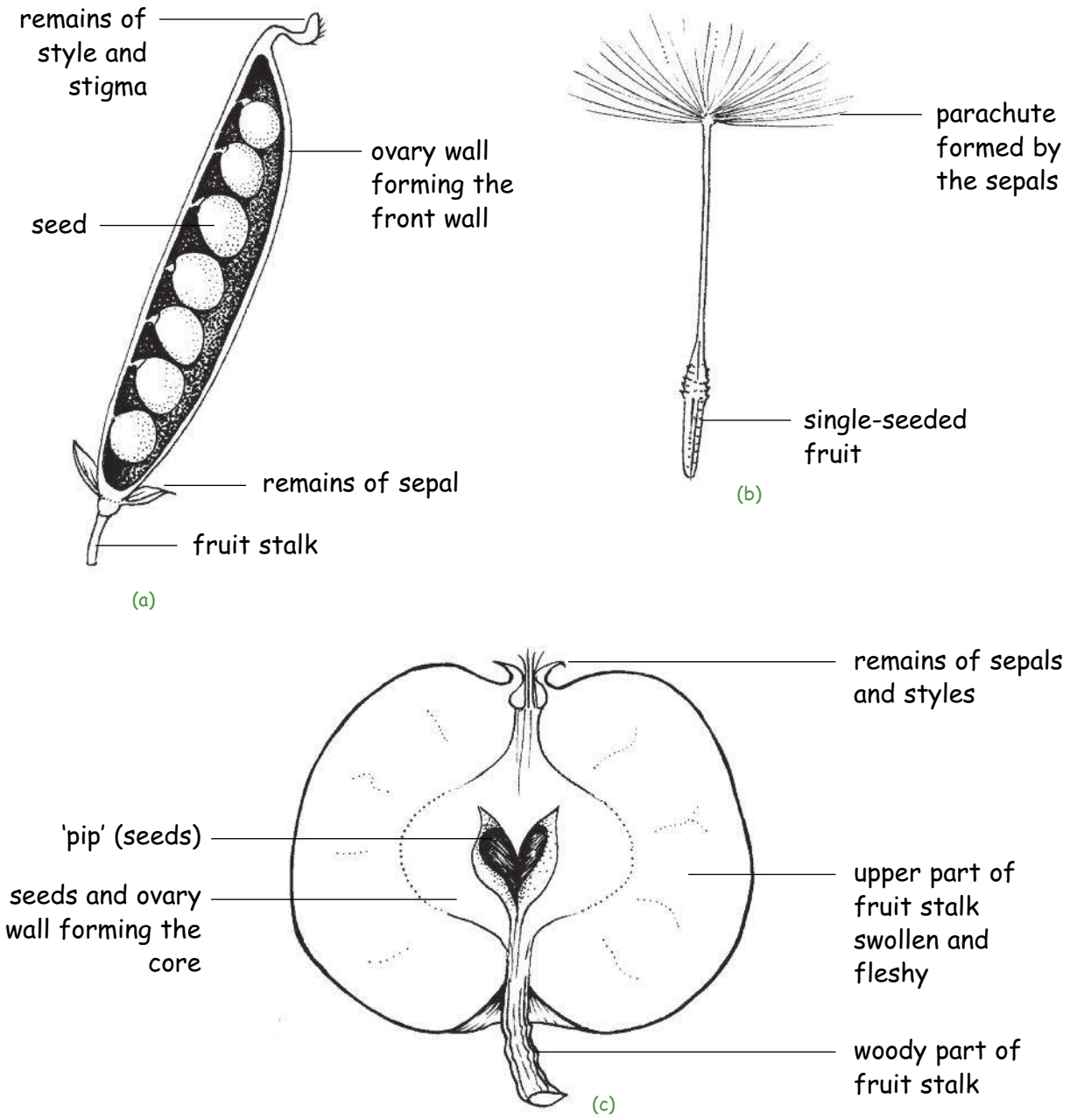


Figure 17. Fruits of (a) pea, (b) dandelion and (c) apple, showing the parts of the flower from which they are formed

The number of seeds formed

Many of the seeds which are formed either do not land in a suitable place to grow or do not survive the early stages of growth. Plants generally produce large numbers of seeds, which helps to make sure that at least some new plants survive. In poppies for example, each capsule produces thousands of small black seeds. Up to 40 000 have been counted in a single capsule of the common field poppy. In the Horse-chestnut, only one or two shiny conkers (the seeds) are usually seen in the prickly case. Each tree however produces thousands of flowers.

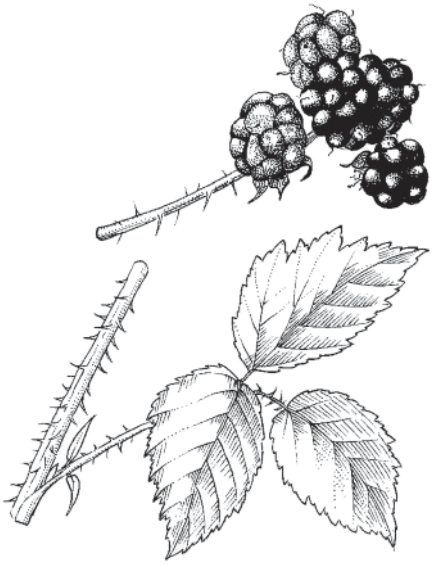
Dispersal

It is important for a plant to spread its seeds away from the parent plant and from each other, in other words to disperse them. This prevents overcrowding, reducing competition for light, water and mineral salts.

Seeds, or fruits contains seeds, are dispersed in four main ways:

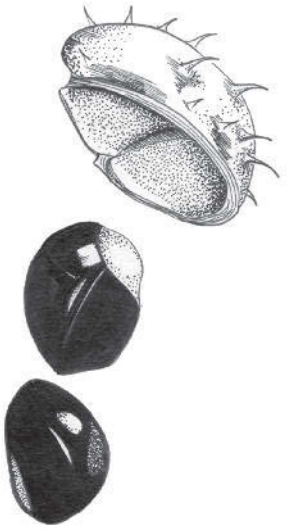
1. Animal dispersal – these are moved by animals. Some are used as food sources (**juicy fruits and seeds** and **takeaways**) others have hooks and bristles that get caught in the animal's coat (**hitch-hikers**)
2. Wind dispersal – some are tiny and float in the air like dust, others have special structures such as wings and parachutes to keep them airborne longer.
3. Water dispersal – this is important for plants growing in or by water, the seeds need to be buoyant to float.
4. Self dispersal – this group includes **exploders,** where the seeds are forcibly flung out of the pod when ripe and **pepperpot** types, where the seeds are shaken free.

The size, shape and colour of the fruit or seed, together with other features all help to give an indication of how they are dispersed. Some examples are given on pages 32 and 33. Many other examples of dispersal mechanisms are described on the FSC fold-out chart – *A guide to fruits and seed dispersal* (OP71). Images from this chart are available on the SAPS website and can be downloaded for teaching purposes.



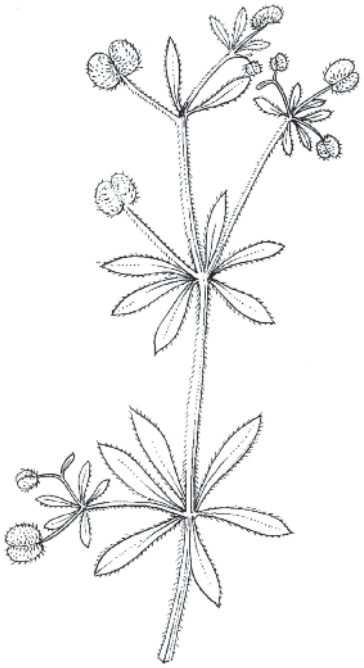
(a) Blackberry (a juicy fruit)

This is a collection of individual fruits, each with a seed in the centre. It is juicy, shiny and brightly coloured to attract animals, particularly birds. The fruit is eaten but as a hard coat protects the seed it passes though the digestive system and is deposited in the animal's faeces.



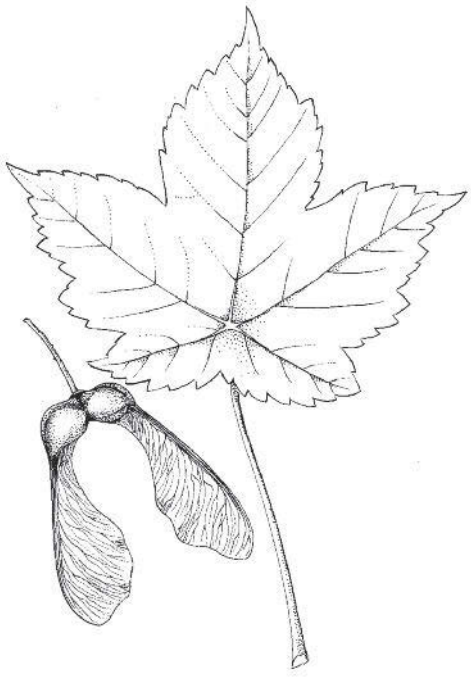
(b) Horse-chestnut or conker (a takeaway)

The shiny brown seeds are enclosed in a prickly case formed from the ovary wall. When ripe this splits to release the seeds. The seeds are a good food source for small mammals; some are carried away and buried as a winter food store. These often get forgotten so will have a chance to grow.



(c) Cleavers (a hitch-hiker)

Pairs of small round fruits, the leaves and stems are all covered in hooked bristles. The bristles cling to animals' fur so seeds get carried away. Long pieces of stem, with many fruits, may be seen trailing from animals' coats.



(d) Sycamore (wind dispersal)

After fertilisation each of the two carpels develops a wing on one side. As the fruit ripens the two carpels separate and the off-centre wings make it spin helping to keep it in the air.

Figure 18. Some fruits with their seeds, illustrating different methods of dispersal

(e) Thistle (wind dispersal)

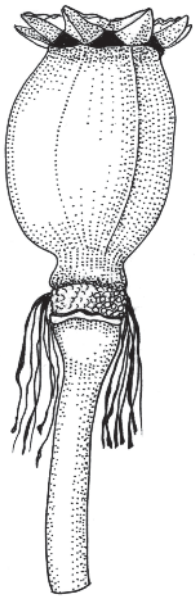
The small single-seeded fruits are suspended beneath parachutes formed from the sepals.

(f) Yellow flag Iris (water dispersal)

The elongated capsules split to release relatively large seeds into the water.

(g) Gorse (an exploder)

As the fruit ripens, the fruit wall dries and twists until the two halves of the fruit wall are pulled violently apart and the seeds shoot out.



(h) Poppy (a pepperpot)

The poppy capsule is full of small black seeds. When the seeds are ripe, small holes develop around the top of the capsule. As the stiff stalk is knocked by passing animals or blown by the wind, hundreds of tiny seeds are thrown out.

Figure 18 (continued). Some fruits with their seeds, illustrating different methods of dispersal

Further information

For help with identification of wild flowers, you will find it useful to look at the FSC fold-out charts, obtainable from FSC Publications.

FSC Publications, Unit C1, Stafford Park 15, Telford TF3 3BB.
Telephone: 0845 345 4072
e-mail: publications@field-studies-council.org
www.field-studies-council.org

Farley *et al. Playing field plants* (2005). OP97.

Bebbington A and Bebbington J *Guide to grassland plants 2 (chalk and limestone)* (2005). OP95.

Gulliver *et al. Grassland plants 1* (2002). OP68.

Gulliver *et al. Woodland plants* (1998). OP50.

FSC

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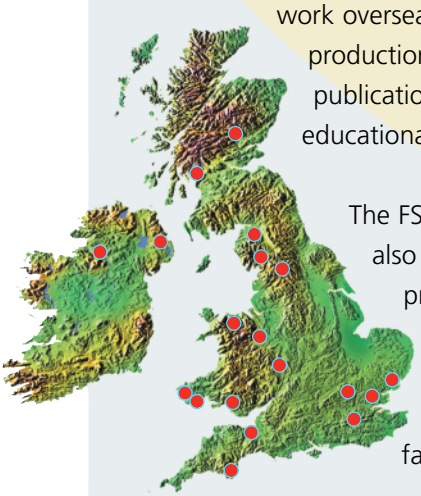

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Reproduction and life cycles

Part 2: Pollination, fertilisation, fruits and seed dispersal

Pollination, fertilisation, fruits and seed dispersal is Part 2 of the second topic in a series of booklets developed to support primary pupils learning with and about plants in England, Wales, Northern Ireland and Scotland. Part 1 introduces pupils to the basic parts of a flower and their functions. The topic continues in Part 2, which provides a range of activities (inside and outside the classroom), including ways to demonstrate pollination, observations on the colours of flowers, investigations into how seeds are dispersed, and an overview of the whole life cycle of the rapid-cycling *Brassica*. It includes activities that are fun but at the same time reinforce pupil learning and help them to be ready to move onto the next stage.

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