Flowers Fact Sheet and Dissection Guide

Phacelia campanularia, an example of a 'complete' and 'perfect' flower.

In order to clearly illustrate the reproductive mechanism within a flower it is necessary to dissect the flower by making a cross-section by cutting through the flower with a scalpel or opening the flower up. Thereafter the various parts can be observed, measured and removed if necessary for illustration purposes.

It sounds fairly straight forward however there are many different reproductive arrangements and it will take some time to familiarise yourself with the variations within different flower types.

If you have seen a standard dissection photograph or illustration of a flower you will soon realise that the flower type shown is more often than not different from the one you are trying to illustrate… It can be very confusing, but don't worry just concentrate on one subject at a time at a time and it will be manageable!

This fact sheet provides background information for flower parts which will be useful when you dissect flowers. It also guides you through the process of a simple dissection of a flower.

A few basic background facts about sexual reproduction in plants:

Plants with structures for sexual reproduction where the final product is seeds are called **spermatophytes (seed plants)**

There are **two groups of spermatophytes**

1. **Gymnosperms –** these are **plants with 'naked seeds',** i.e. seeds without and ovary encasing the ovules e.g. Conifers, Cycads, Ginkgo. There are approximately 1000 species of gymnosperms within 14 families.
2. **Angiosperms – flowering plants with seeds enclosed within an ovary.** There are thought to be 250-400,000 species of flowering plants within 413 families

***Note: We will focus on the flowering plants for the time being**

Types of reproductive mechanism in flowering plants

1. The **most common** floral reproductive mechanism is the **'androgynous' or 'hermaphrodite'** flower i.e. **with both male and female reproductive parts within the same flower**. Also described as **'bisexual' and 'perfect'** flowers.
2. **Monoecious** plants have **separate male (staminate) and female (pistilate) flowers on the same plant**. Also described a **'unisex' and 'imperfect' e.g.** Oak, Alder, Corn and Squash plants.
3. **Dioecious**: plants that have **male (staminate) and female (pistilate) flowers on separate plants** e.g. Ivy, Date Palm and Asparagus. Also described a **'unisex' and 'imperfect'**. Only around 6% of flowering plants exhibit dioecy.

Note: There are other minor variations and this guide is a broad description.

Flower Parts and Terminology

Complete Flower, Incomplete Flower, Perfect Flower, Imperfect Flower.

A Complete Flower

A complete flower has 4 parts:

1. **Gynoeceum, Pistil or Carpel –** reproductive **female** parts usually in the centre of the flower comprises **stigma, style and ovary (containing ovules)**
2. **Androeceum or Stamens –** reproductive **male** parts comprises **filament and pollen bearing anther. The stamens surround the pistil**
3. **Petals:** collectively called **corolla–** usually colourful they attract pollinators.
4. **Sepals** collectively called the **calyx –** usually green (but not necessarily) at the base of the flower. The calyx encloses and protect the petals at the bud stage

- Note: the **petals and sepals** are collectively referred to as the **perianth**

Examples of complete flowers include: Lavatera, Roses, Sweet Pea, Hibiscus, Primula

- **Where sepals and petals are similar in appearance** they are called **'tepals'** e.g. tulips, lilies, amaryllis (with 3 outer sepals and 3 inner petals)

An Incomplete Flower

A flower lacking one or more of the 4 parts

Examples: Grasses which are wind pollinated and have no need for brightly coloured petals (or sepals) to attract pollinators. A squash flower is also incomplete being male or female. Hydrangeas and Clematis do not actually have petals bit have 'petal like' sepals, therefore they are incomplete. To identify this feature you will see that the 'petal like' sepals are in a single whorl unlike tulips and lilies where similar sepals and petals are in two whorls.

A Perfect Flower

Has **both male and female parts present** but is not necessarily 'complete'. *Remember all complete flowers are perfect but all perfect flowers are not necessarily complete*

Examples: Tomato, roses, dandelion are all perfect and complete. Hydrangea and Clematis are incomplete but perfect.

An Imperfect Flower

A flower that has **either male or female** parts; i.e. the **monoecious or dioecious plants** described on page 1. Note: **An imperfect flower is always an incomplete flower** because it has one of the 4 component parts missing.

Examples: Courgette flowers (monoecious) Eastern Cottonwood (dioecious)

Finally a word about Male and Female Phases is Hermaphrodite Plants

The separation of male and female parts in either monoecious or dioecious plants has evolved to ensure cross-pollination, which gives the advantage of greater genetic diversity. However many hermaphrodite flowers also have adaptations to promote cross-pollination, while many are able to self-pollenate they often exhibit male and female phases with the parts being active/receptive at different times. This is a form of separation that prevents self fertilisation. This adaptation is called **dichogamy:**

Protogyny: Female phase first followed by male

Protandry: Male phase first followed by female

***Phacelia campanularia* is a complete and perfect flower, which exhibits protandry.**

What does this mean?

Complete: it has all 4 components (stigma (female), stamens (male), petals and sepals)

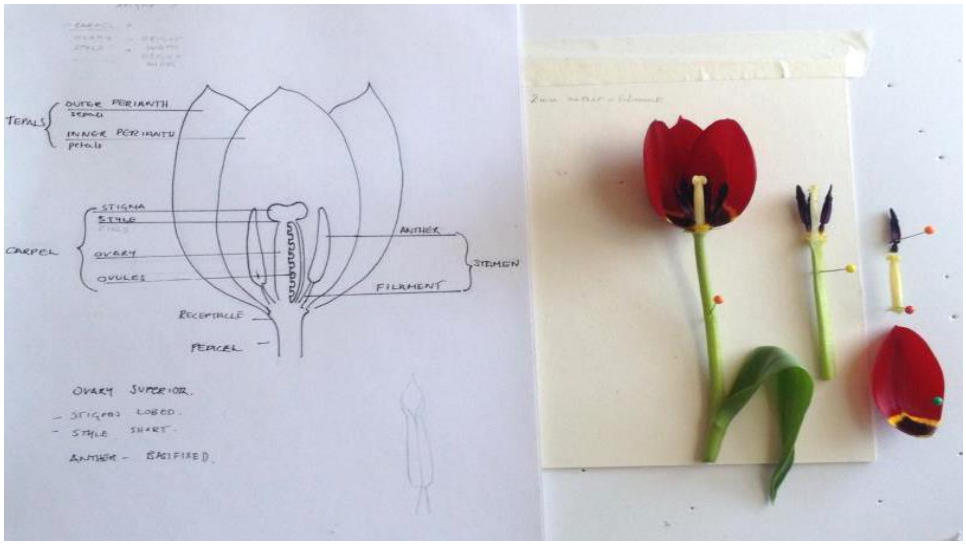
Perfect: All 'complete' flowers are 'perfect' i.e. have both male and female parts (hermaphrodite)

Protandrous: You can see in the above images the male and female phases of the flower. On the left, the male phase occurs once the flower opens, the stamens are extended and the stigma closed with a short style. In the image on the right, the stigma /style has extended and opened and is receptive the stamens are no longer active. This creates a form of separation that promotes cross-pollination.

If you observe the reproductive phases of flowers you will often see the stigma is short initially and the anthers full after they open. Once the male phase is finished and pollen dehisced, the female parts extend. You will see an example with the Lavatera dissection video.

Flower parts are extremely varied any good text book such as the Cambridge Illustrated Glossary to Botanical Terms (Hickey and King 2000) will help you to become more familiar with the variations within flowers.

Dissection of a Flower



Tools and Materials

1. A freshly opened flower, you will need several
2. A cutting surface, e.g. self-healing cutting mat or foam board
3. White foam board or card to mount the specimen
4. A sharp scalpel of craft knife
5. Dress making pins of fine wire to mount the specimen
6. A clear Perspex ruler marked in mm
7. Tweezers

The first step is to **identify all of the parts**, and **to determine which parts are important** for the illustration.

A complete flower can be broken down into 4 parts:

1. At the **centre of the flower you find the female parts**, called the **carpel** (comprises: stigma, style, ovary with ovules inside)
2. Surrounding the carpel are **the male parts** the **stamens** (filament and anther)
3. Petals
4. Sepals – 3 & 4 known collectively as the **perianth**.
During the dissection be sure to measure all the parts and make notes on the following:

- Stigma, style and ovary
- Anther, filament, pay careful attention to the type of attachment of the anther to the filament
- Petals and sepals or tepals
- Stem

Make a note of:

Length and width of all parts always note the widest part of any petal or anther etc.

Decide whether or not you need to scale the parts up or down in size for illustration purposes. If it's a simple measurement conversion it's fairly easy to do but there are some scale converters available on the internet. Generally used for models but useful for plant parts too! Here's one I found

http://jbwid.com/scalcalc.htm

To dissect the flower and reproductive parts carefully remove the front petals at the base (receptacle) using the scalpel. This will give you a better view of the interior of the flower for cutting.

Make observations and notes of any changes in the flower, often the anthers are open at a different time to the stigma receptivity (to prevent self-fertilisation). The parts will change in a flower depending on when they are sexually active or receptive, the stigma/ style may be short at first while the anthers are opening and then grow above the anthers.

Before the dissection, you may chill the flower first to prevent it from wilting and to make it easier to handle.

Pin the flower to a piece of foam board using standard dressmaking pins or fine wire. The less you handle the flower the better - use tweezers to limit the handling time.

Make a clean cut straight down the centre of the stigma style and ovary. This can take some practice and often you will take too little or too much. The aim is to make an even cut exposing the ovules in the ovary. For flowers with fused parts, e.g. Primula or Freesia, you may cut them open on one side and open them out flat instead. You may also choose to remove the individual male and female reproductive parts to illustrate separately. This will depend on the individual flower and its features. Remember the aim is to allow the viewer to see what is going on inside the flower.

Once dissected the **parts will dry out very quickly**, you can spray with a little water to prolong the life of the flower parts but **you will need to work quickly**. Try to have several flowers to work on.

You may also wish to illustrate the complete or dissected male and female parts separately. The approach is the same but there is no need to cut through the centre of the flower, instead carefully remover the surrounding sepals and petals, dissect the ovary if necessary and pin the parts to the foam board.

Typical arrangement of dissected parts, lined up along the bottom of the illustration. A dissected carpel (far left) and stamen. On the far right a seed is also included.

After measuring and identifying draw the dissection and parts using a fairly hard pencil 2H. You may decide to keep them as simple graphite line drawings for clarity or complete as tonal drawings or painted. The choice is yours. Sometimes the use of graphite looks better because it does not detract from the main study of the plant.

It is normal convention to **arrange the individual reproductive parts at the bottom of the painting and evenly line up the parts, writing the scale (if it is different) below each part, alternatively you may wish to use a scale bar.** You may place the parts elsewhere on a work depending on what makes the best composition. Fruits and seeds can be added at a later date when they are mature so keep this in mind when planning your painting and leave a space if you intend to do so.