Laboratory 2
Reproduction in Flowering Plants

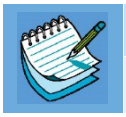
Laboratory Sessions

Date	10 February 2022 (Thursday)			
Time	1000-1200	1200-1400	1400-1600	1600-1800
	Group 1	Group 2	Group 3	Group 4
Venue	Life Sciences Teaching Laboratory 3, Lee Wee Kheng Building, Block S1A, Level 4			

Safety Requirements

1. You are required to put on **close-toed** footwear. **You will not be allowed to enter the laboratory if you are wearing sandals, slippers or any other open-toed footwear**.
2. You are also required to wear pants that **cover your legs**. **You will also not be allowed to enter the laboratory if you are wearing shorts, including bermuda shorts or skirt**.
3. Please bring the disposable laboratory coat that was issued to you at the first laboratory session. If you had forgotten to bring it, you will have to **purchase** a new disposable laboratory coat at the laboratory

Key Personnel



1. Teaching Assistant – Ms Law Sze Joo Sylvia (dbslsjs@nus.edu.sg)
2. Laboratory Officer – Ms Chua Ling Lih (dbscll@nus.edu.sg)

Attendance

1. Please be **punctual**. **You will not be allowed to enter the laboratory if you arrive later than 5 minutes after the time the laboratory session is scheduled to begin**.
2. Please ensure that your attendance is marked. Failure to do so will result in a **50% penalty**.
3. Please attend the group that you have been allocated to. For logistical reasons, you will not be allowed to make an **arbitrary switch** to another group
4. If you are unable to attend the session due to illness or compassionate reasons, please **contact the Teaching Assistant** as soon as possible. Please ensure that you produce an acceptable official documentation, e.g. doctor's letter, relative's death certificate, etc. Under such circumstances, the weightage of the laboratory assignment will be evenly distributed to the other components of the continuous assessment (CA).

ASSIGNMENT

Weightage	5%
Deadline	**2359hrs, 16th February 2022(Wednesday)**
Missed Deadline	Refer to FAQ

INSTRUCTIONS

1. Please download the file named '**Laboratory Assignment 2.docx**' from the sub-folder of the '*Handouts for tutorials/practicals', 'Laboratory - Reproduction in flowering plants'* folder of the '*Files*' tool. **Watch** the video on the use of a compound microscope before class.
2. Before submission, please rename your file according to the following format, **NUSNET ID-lab02**. If your NUSNET ID is *e0234567*, the filename should be *e0234567-lab02*. Files that are not renamed according to the stated format will be subjected to a **10% penalty**. Upload to the folder *'Submissions Lab 2'.*

3. Please note that marking **will not** be based on **keywords alone** but will also depend on how the explanations and descriptions are expressed.

INTENDED LEARNING OUTCOMES

The main aims of this assignment are to continue learning about reproduction in plants, and give you an opportunity to explore the diversity of fruit types. At the end of this laboratory session, you must be able to (1) identify and know the function of the main parts of a typical angiosperm flower, fruit and seed, (2) identify an angiosperm as a monocot or dicot based on its morphology, (3) examine a flower or fruit and determine the carpel number, and (4) describe the life cycle of an angiosperm. Good luck and have fun!

INTRODUCTION

Plants have been incredibly important in shaping life on Earth as we know it today. Many other organisms use them as a source of food, depending on plants' ability to transform solar energy into chemical energy through photosynthesis. The flowering plants – or angiosperms – have evolved to become the most successful group of plants and are a major component of our own diet. In this practical, you will be dissecting the reproductive parts of angiosperms: flowers, fruits and seeds.

FLOWERS

Flowers are the sexual reproductive structures of angiosperms, and are involved in the production of gametes and gametophytes. Flowers may contain only male reproductive structures or only female reproductive structures, but most angiosperm species contain both male and female parts (called a 'perfect' flower).

Parts of a flower:

- **Pedicel** – stalk of the flower that attaches it to the stem
- **Receptacle** – end of the pedicel and the central base of the flower
- **Sepals** – outer leaf-like structures that enclose the flower when it is immature; in some species, the sepals look similar to the petals
- **Petals** –broad and brightly colored structures that attract pollinators.
- **Stamens** – male parts which consist of the **anther**, a football shaped structure that bears the pollen grains and the **filament**, which is thin and stalk-like
- **Carpels** – female parts, consisting of the **ovary**, a swollen structure that contains the ovules, a stalk-like **style** and the **stigma**, which is the sticky broadened tip; if parts of the carpels are fused into one, you can determine the true number by counting the lobes of the stigma.

TASKS

1. Examine the flower provided and identify the different parts listed above.
2. Determine the following information:
   - What is the name of the flower?
   - How many sepals, petals, stamens and carpels are present?
   - Is the flower missing any parts?
   - If the flower from a monocot or dicot plant? Generally, monocots have their flower parts in threes or multiples of three. Dicots have the flower parts in fours or fives or multiples thereof.

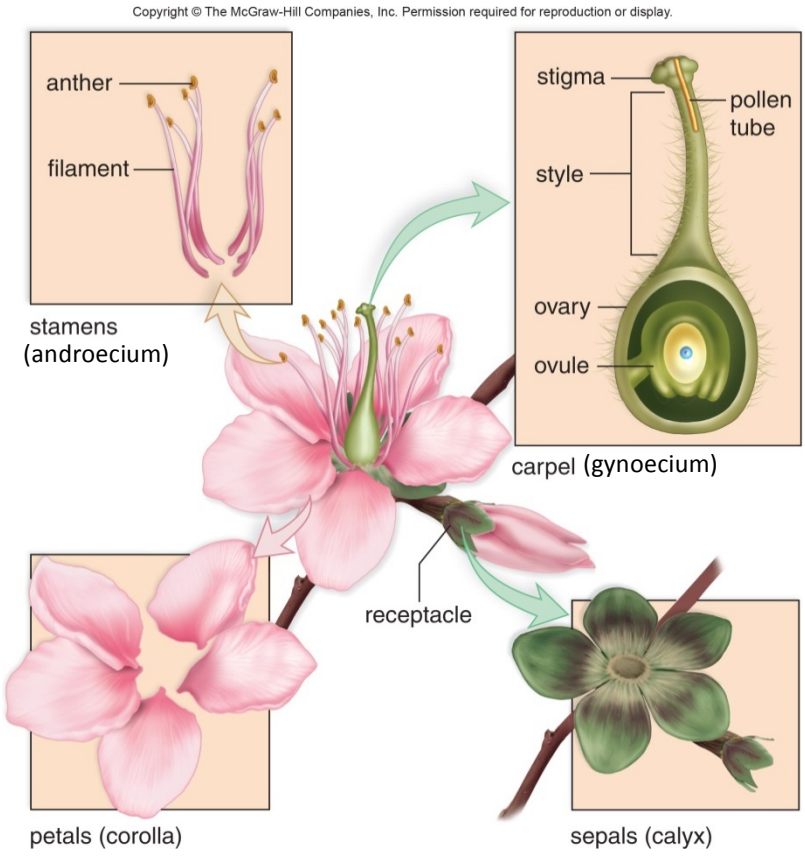
Parts of a flower

Note:
Gynoecium is all the carpels together

Androecium refers to all the stamens together

Corolla is all the petals together

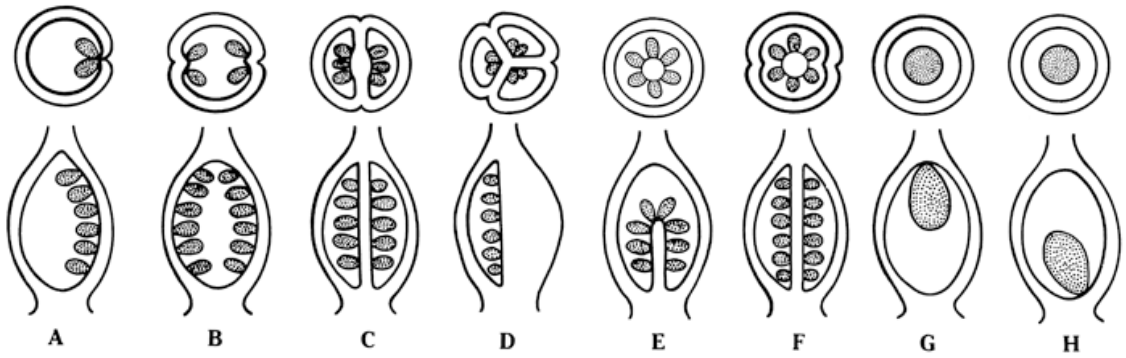
Calyx is all the sepals together



3. Remove the sepals, petals and stamens until you can clearly see the ovary. Cut the ovary with a plastic knife to expose the inside. If possible, cut both a cross-section and a longitudinal section. Use the dissecting microscope to examine the ovary and ovules under higher magnification. Observe the following:
   - How many chambers does the ovary have?
   - How are the ovules attached to the ovary wall? Determine the placentation type of the ovary.

Types of placentation

Image from New South Wales Flora Online



A = marginal; **B** = parietal; **C** = axile (ovary with 2 loculi); **D** = axile (ovary with 3 loculi); **E** = free-central; **F** = free-central; **G** = apical; **H** = basal. Ovaries shown in cross section, with the longitudinal section below.

4. Prepare a slide of the pollen from a lily flower. Tap the lily anther a few times on a clean glass slide. Place one drop of aceto orcein stain on the pollen grains and then cover with a cover slip. Leave for 15-20 minutes for the stain to penetrate the pollen coat then examine the slide using the compound light microscope.
   1. How many nuclei are found inside the pollen grain?

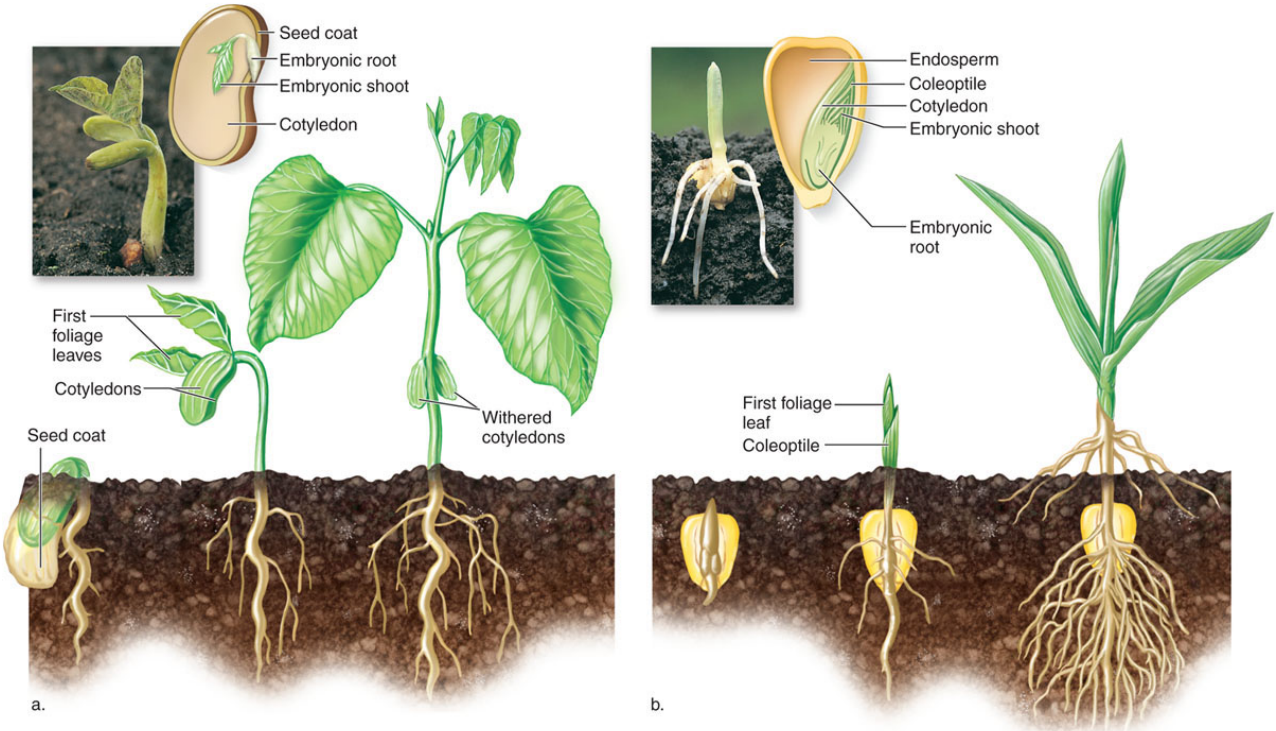
Please exercise care when using the aceto orcein stain as it may cause irritation if it comes into contact with your skin.

FRUITS AND SEEDS

When a flower is fertilized, **fruits** develop from the ovary and other structures associated with it. The wall of the ovary becomes the fruit wall or **pericarp**, while the seeds are maturing. Fruits can be classified as **dry** or **fleshy** depending on the characteristics of the pericarp. A fruit functions to help disperse seeds away from the parent plant. Some fruits eject their seeds when they dry, some are passively transported by wind or water, while most fleshy fruits are eaten by animals that travel away from the parent plant as they digest and eventually pass the seeds with their waste.

Seeds develop from the fertilized ovules and contain the embryonic plant and stored food for the embryo's development. The **cotyledons** are parts of the seed that help in nourishing the growing embryo. The dormant embryo is like a miniature plant - you can distinguish the **embryonic leaves, stem and roots**, especially in the eudicot seed. When a mature seed encounters the right environmental conditions, the embryo will resume its growth in a process called germination.

Seeds and germination in eudicotyledon (left) and monocotyledon (right) plants



a: © Ed Re-schke; b: © Dwight Kuhn

TASKS

1. Examine the sweet pea, cherry tomato, chilli pepper, and longan. Split or cut the fruits open and see how the seeds are attached.
   - What kind of placentation was present in the ovary from which these fruits developed?

2. Crack the peanut shell open and examine the seeds. Remove the seed coat (the papery skin) and carefully separate the two halves of the seed to expose the peanut embryo. Using the dissecting microscope, identify the embryonic leaves, stem and root.
   - The shell of the peanut is the _____.

3. Examine the strawberry. The strawberry is an example of an ***accessory fruit*** because its edible parts do not develop from the ovary wall. Using the dissecting microscope to examine the strawberry, you will able to still identify remnants of different floral structures, particularly the sepals, stamens and styles.
   - What part of the flower did the red flesh of the strawberry develop from?

4. Examine the corn kernel that has been cut in half. Add a drop of iodine solution to the cut surface and observe what happens.
   - What part of the seed does the iodine react with?

Please exercise care when using the iodine stain as it may leave stains on your skin, clothing, and any other materials it comes into contact with.

QUESTIONS

1. Describe the flower which you dissected by stating the following:
   a) Number of sepals, petals, stamens and carpels present
   b) Flower type (male, female or perfect)
   c) Type of placentation in the ovary
2. What color is the 'true' strawberry fruit? What is the purpose of the red flesh?
3. What is double fertilization in angiosperms? Do both of the nuclei you saw in the pollen grain participate in this process? Elaborate on your answer.
4. What substance in the corn endosperm turns black when stained with iodine? What is the function of this substance?
5. You are given a seed from an unknown plant. How would you decide if it is from a monocot or eudicot?