Plant Propagation

Introduction

- What is plant propagation?
  - The reproduction or increasing in number of plants.
- Can be done in one of two ways….
  - Sexual.
  - Asexual.

Sexual Propagation

- The propagation or reproducing of plants from seeds.

Plant Reproduction Home Page

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Flower structure

2 

Pollination

3 

Fruit development

4 

Seed dispersal

5 

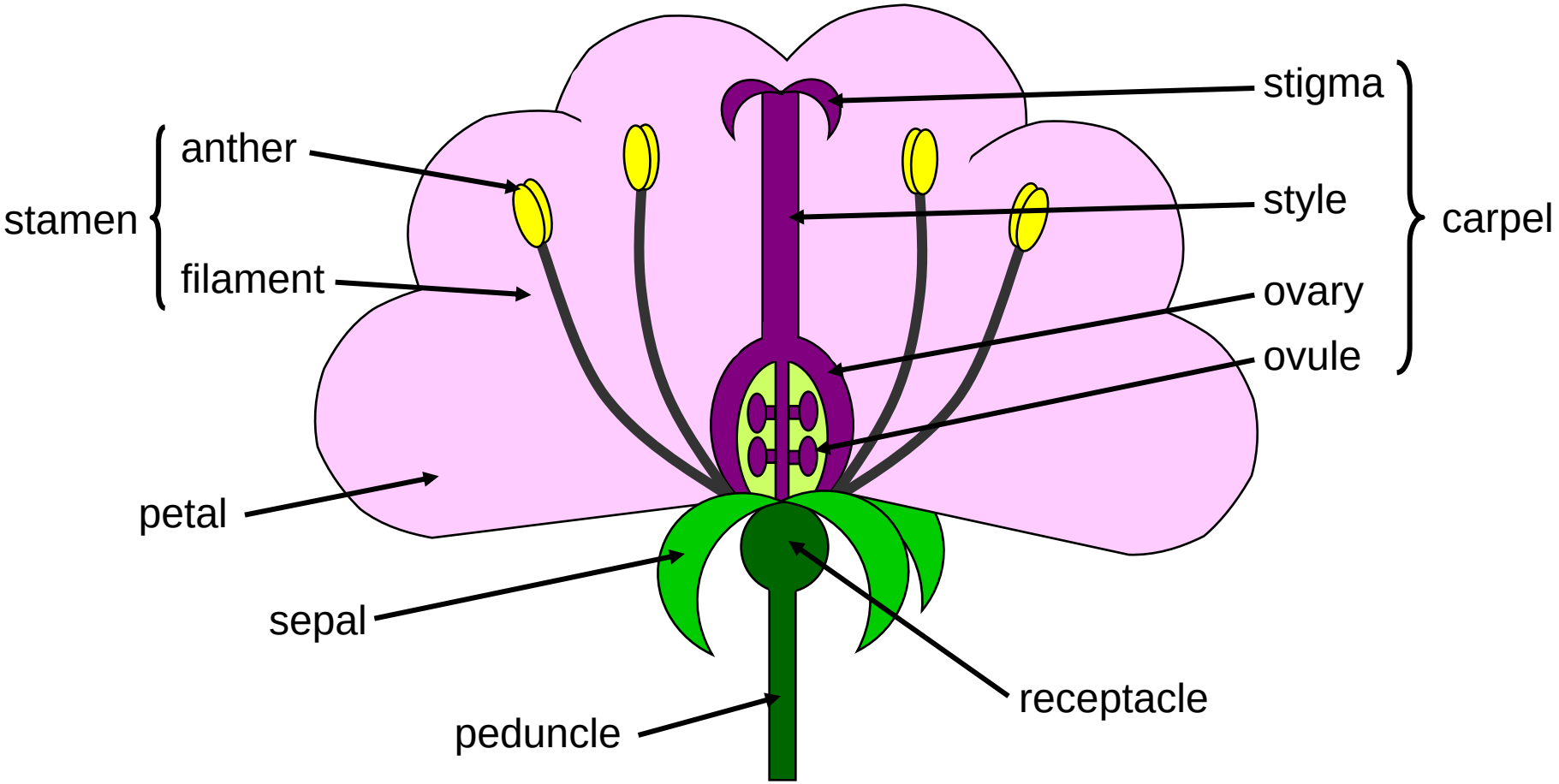
Germination

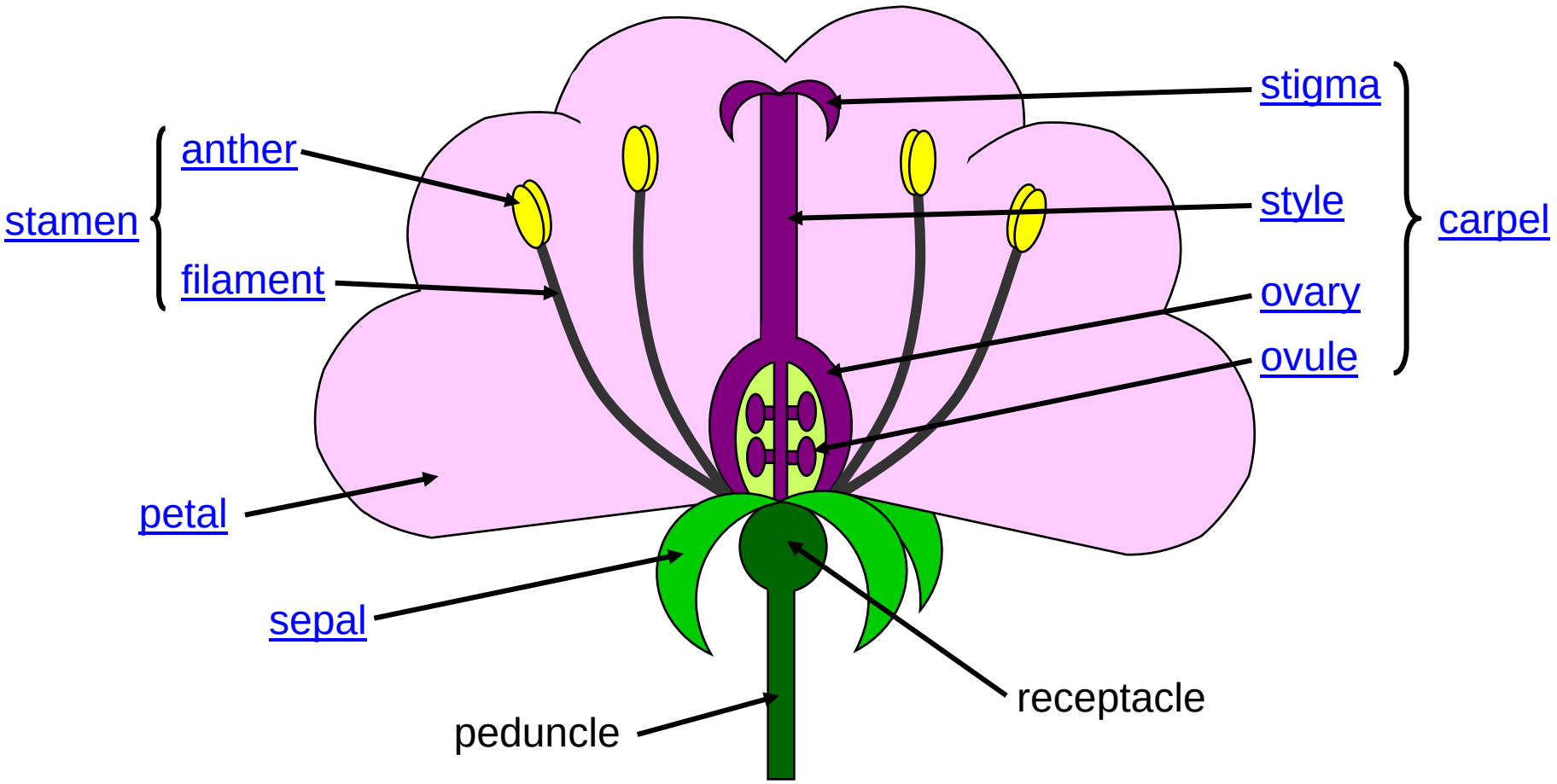
6 

Test

Flowers are the reproductive organs of plants

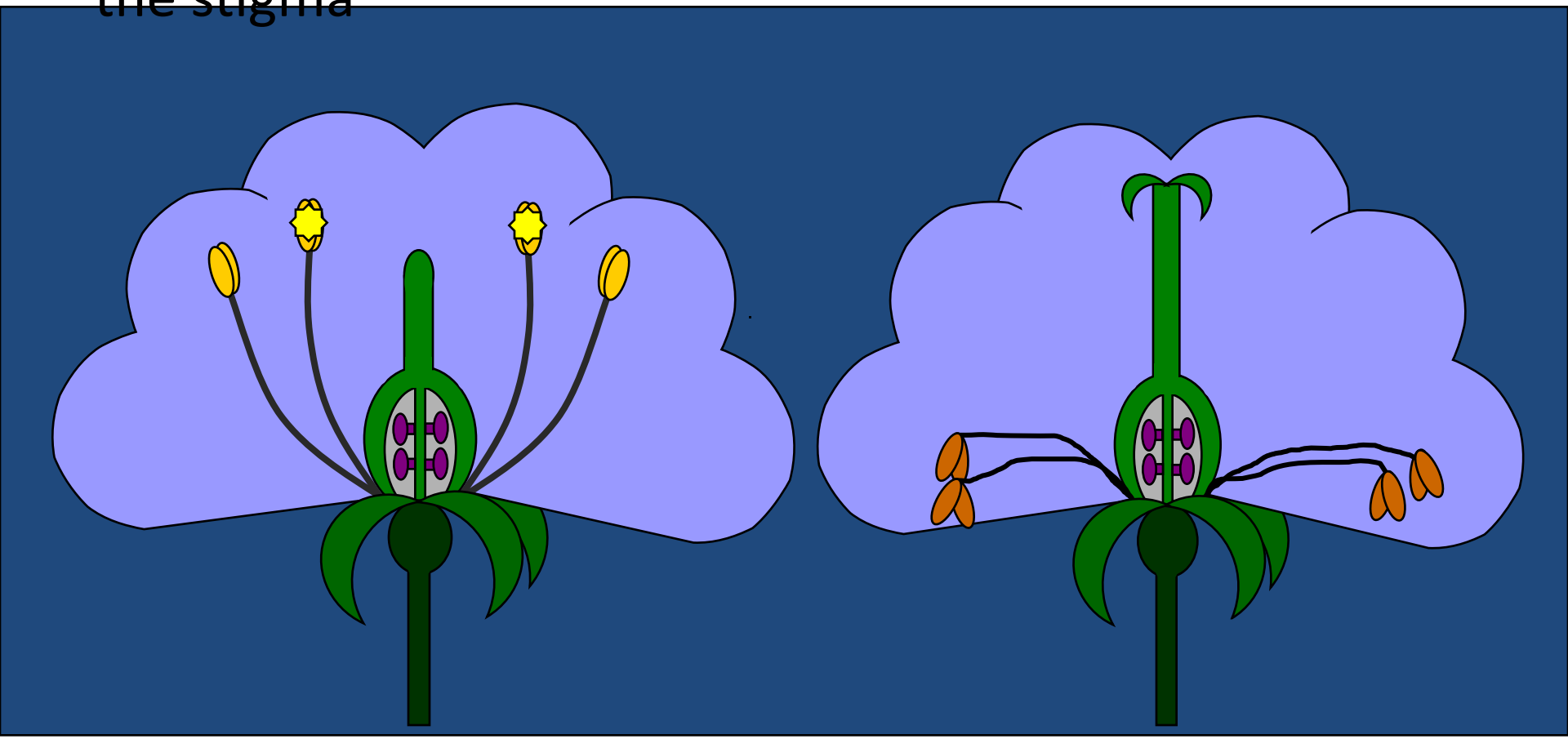
Use the diagram below to complete the labels on the flower structure worksheet




stamen
anther
filament
petal
sepal
peduncle
stigma
style
ovary
ovule
carpel
receptacle

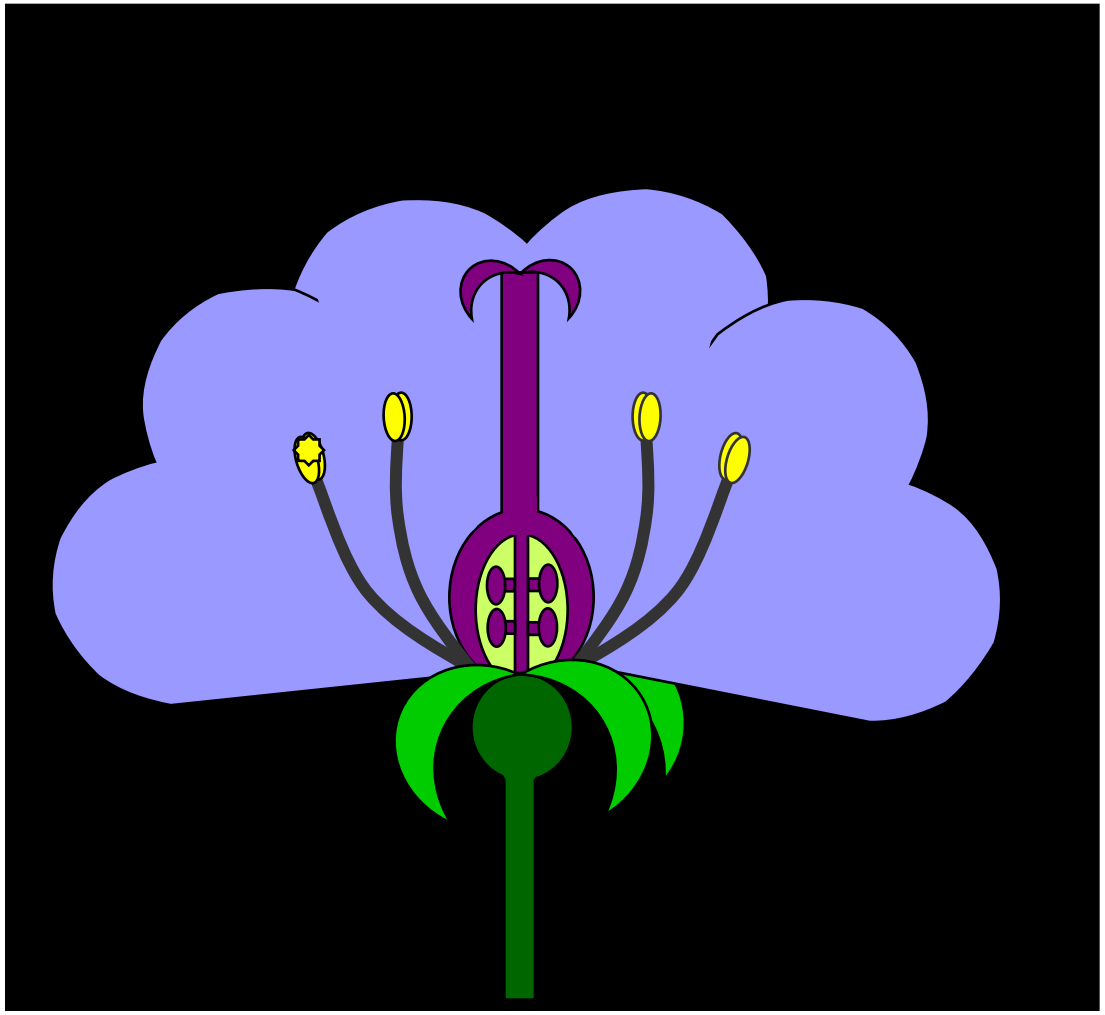
Pollination

Pollination is the transfer of pollen from the anther to the stigma



- This is an example of **cross-pollination** as the pollen travels from one flower to a different flower. This is desirable in plants as it promotes variation.

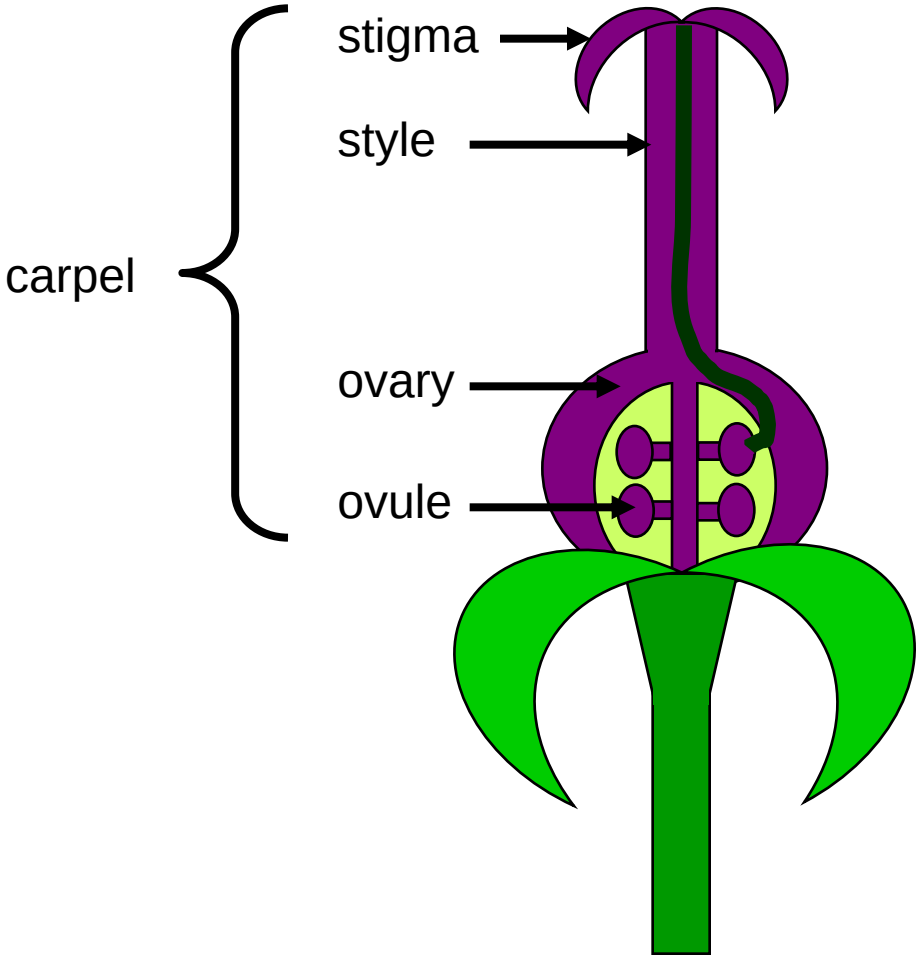
Self-pollination occurs when pollen falls from the anther onto the stigma of the same flower



- Self-pollination is not desirable as it reduces variation

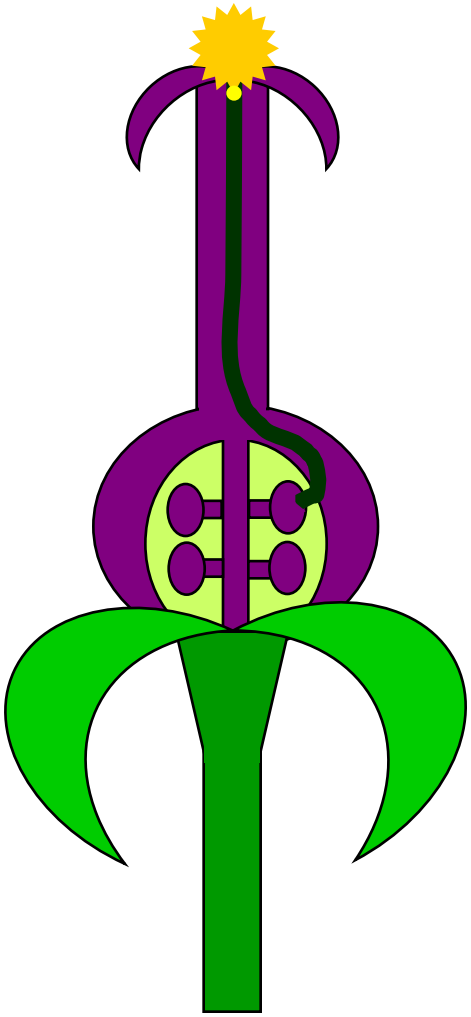
Fertilisation and Fruit Development

Once pollination occurs a tube grows from the pollen grain down through the style to the ovule



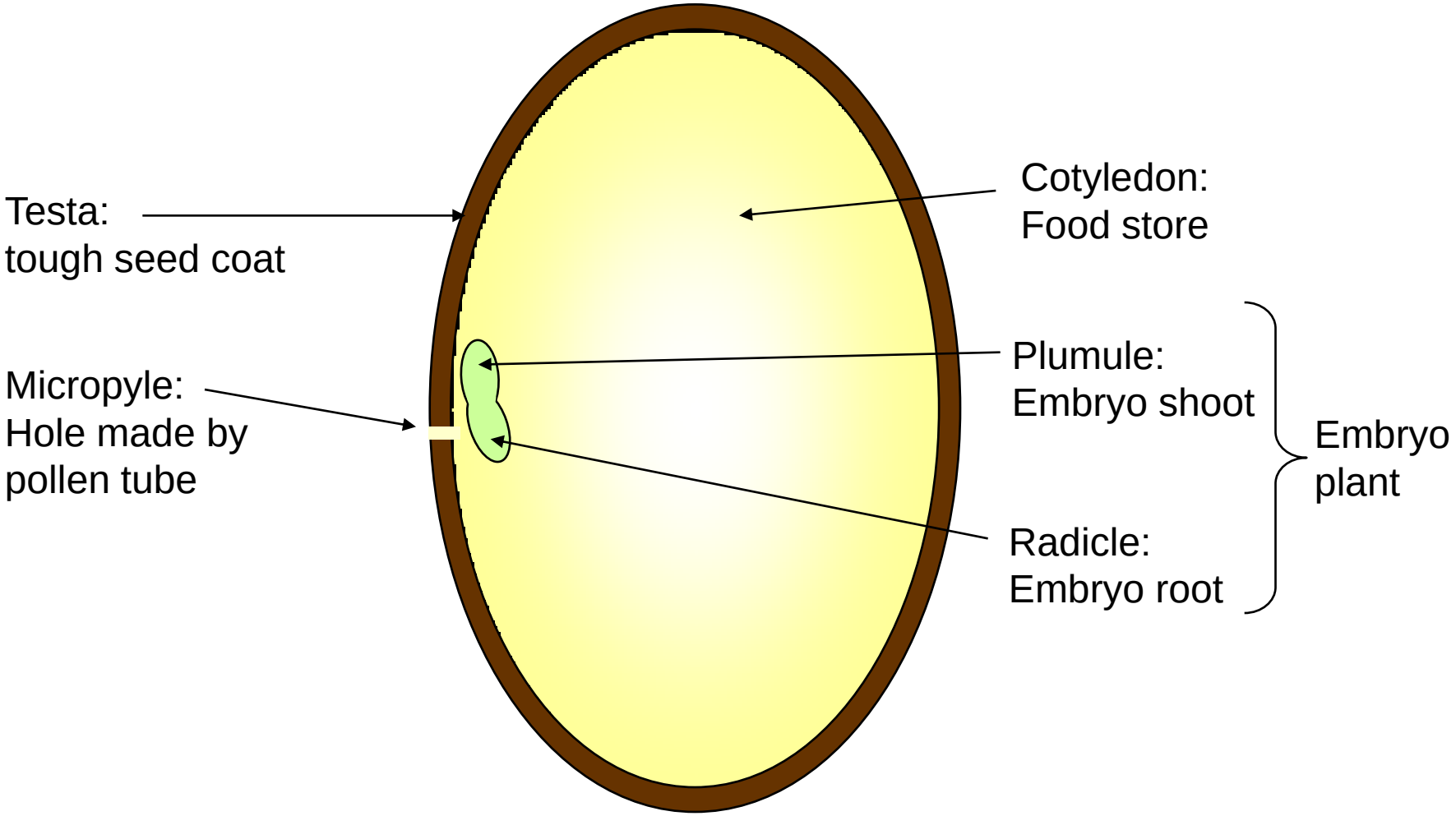
Note: Petals not shown in order to simplify diagram

Fertilisation occurs when the male gamete fuses with the ovule (the female gamete)

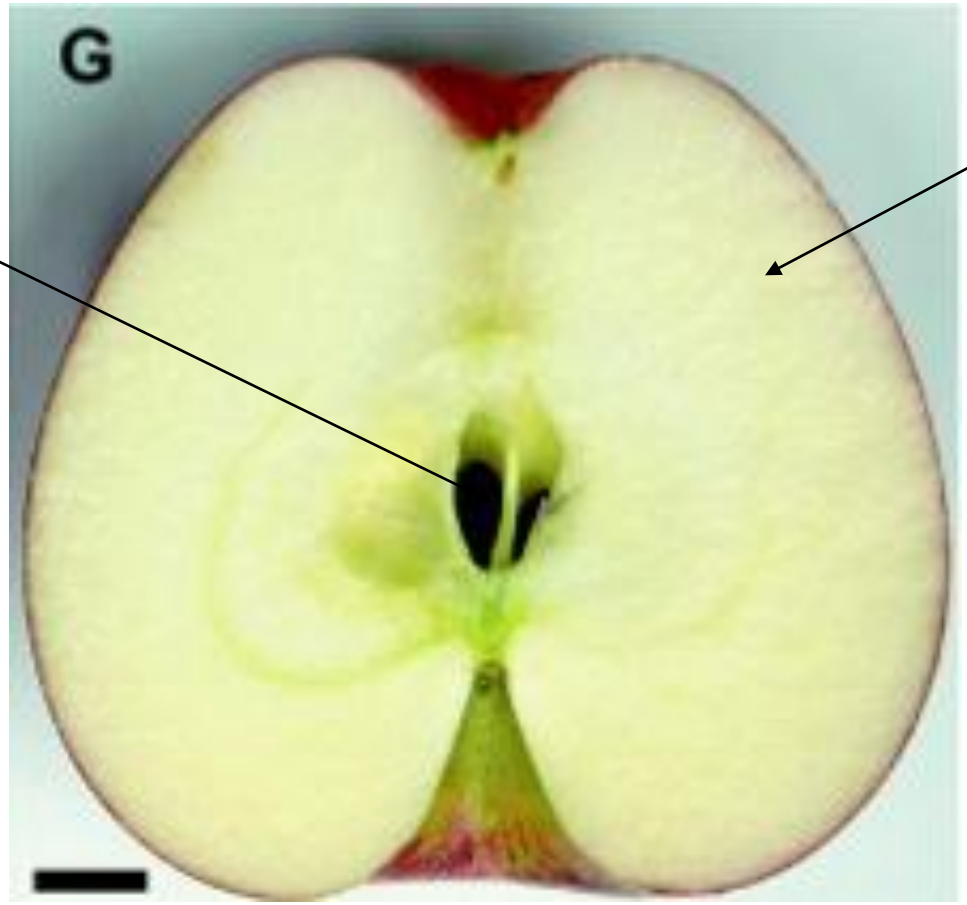


Seed Dispersal

After fertilisation the petals, stamen and sepals fall off. The ovule turns into a seed, the fertilised egg inside develops into an embryo plant.



Water leaves the seed, it dehydrates and becomes dormant because metabolic reactions stop.
The ovary develops to become a fruit.



Seeds need to be dispersed away from the parent plant in order to reduce competition for space, light, nutrients and water.

- Seeds can be dispersed by:

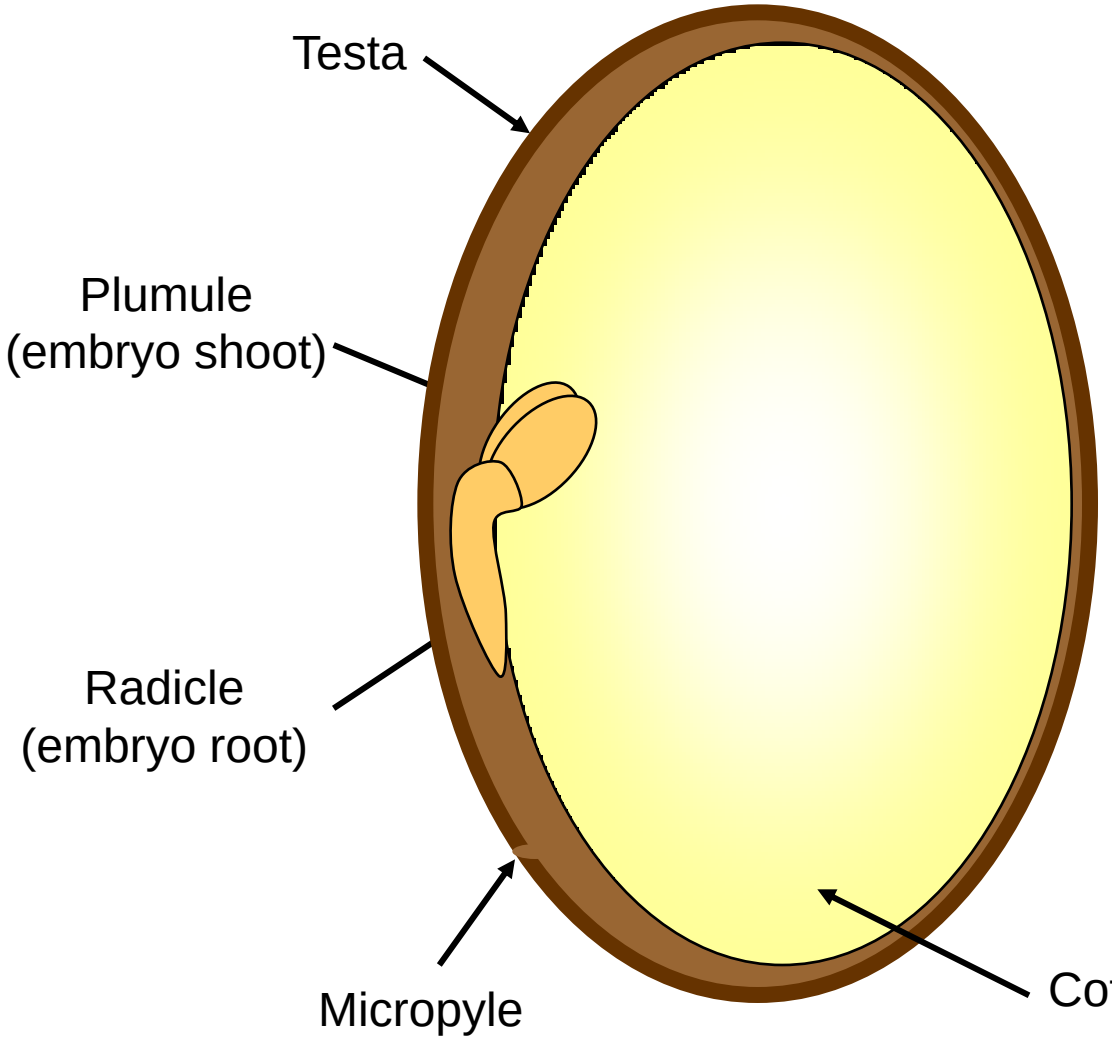
- Wind
- Water
- Mechanical
- Animals





Germination

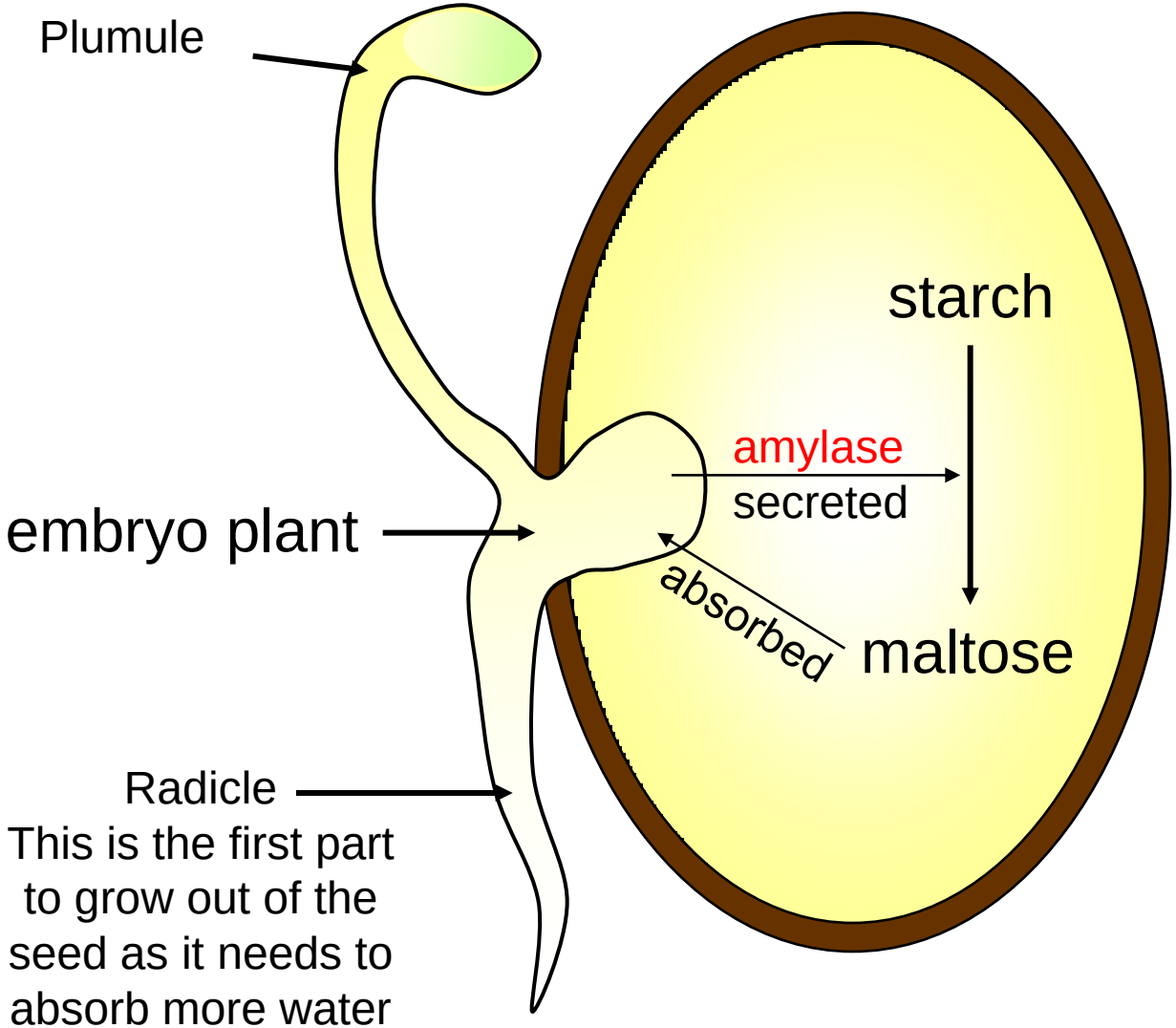
The seed contains the embryo plant and cotyledons (starch stores)



Water enters the seed through the micropyle and activates enzymes.

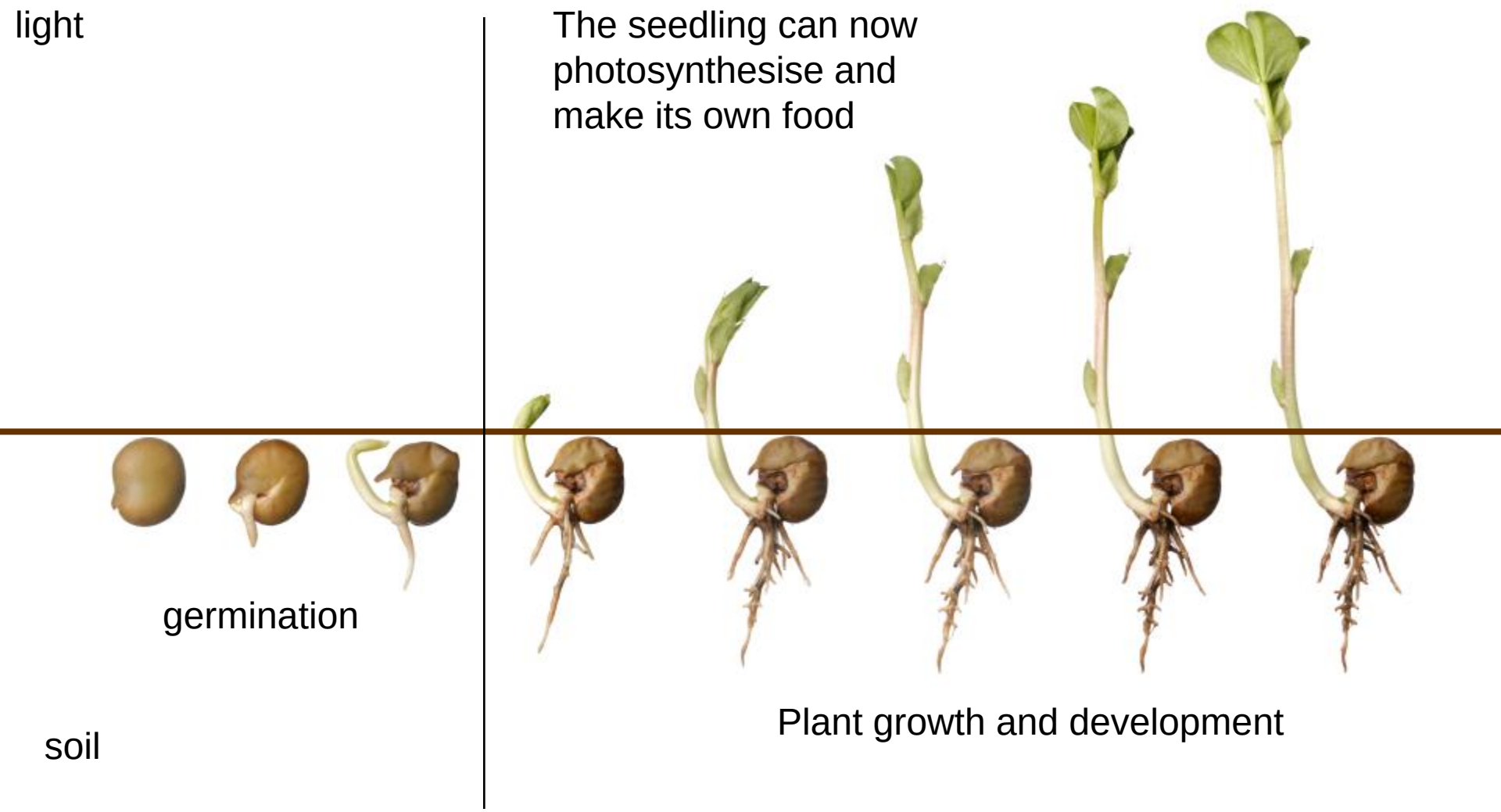
The water also softens the testa to allow it to split.

Enzymes are used in seed germination



The enzymes break starch down into maltose and then glucose. The glucose is used in respiration to provide energy for growth

Whilst germinating the plant uses food stores in the cotyledon to provide energy for growth



Transplanting Seedlings

- Seedlings are the small plants.
- Transplant when first true leaves appear
- Held by the true leaves rather than the stems to prevent stem bruising which will kill the plant.

Seed Culture

- Direct planting
- Transplanting

Hardening Off

- The reducing of humidity and water to make the environment more like the outside.

- Pelletized seeds

- Seed tapes

Disadvantages of Sexual Propagation

- Some plants, especially hybrids, do not reproduce true to parents.
- Some plants are difficult to propagate from seeds.

Asexual Propagation

Asexual Propagation

- The use of growing parts other than seeds to reproduce plants.
- The types are….
  - Cuttings
  - Layering
  - Division/Separation
  - Budding
  - Grafting
  - Tissue Culture

- Apomixis

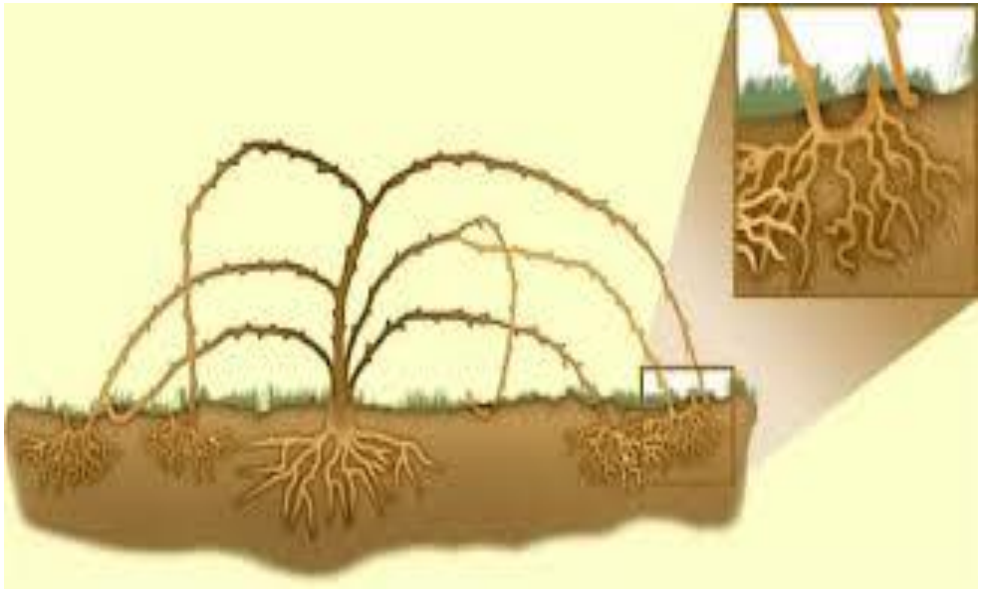
- Runner

- Sucker

Layering

- The rooting of plant parts while they are still attached to the “parent” plant.
- The types are….
  - Air Layering.
  - Trench Layering.
  - Mound Layering.

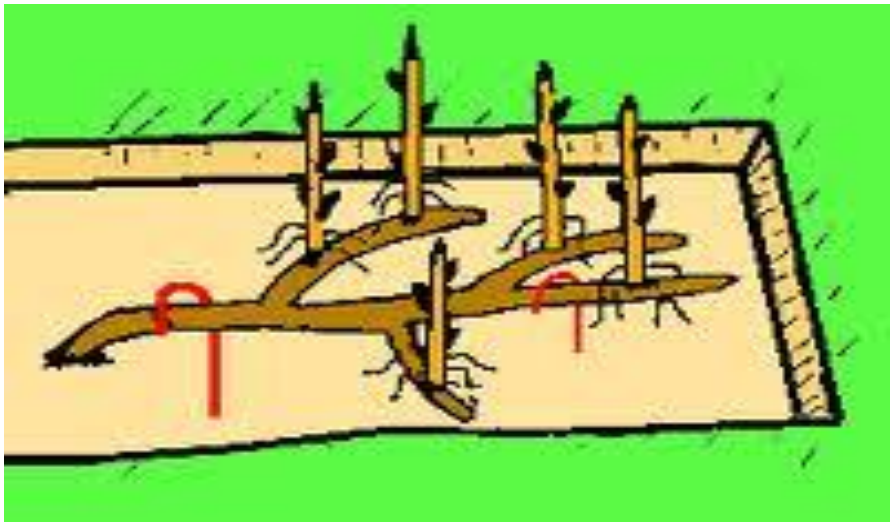
Tip Layering



Simple Layering

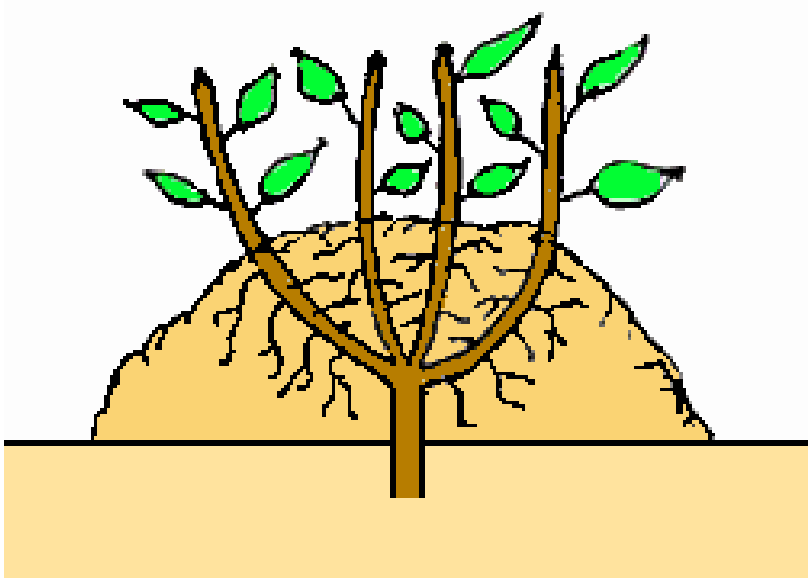
Trench Layering

- Mother plant is bent to the ground and buried.
- Plants form at each node on covered stem.



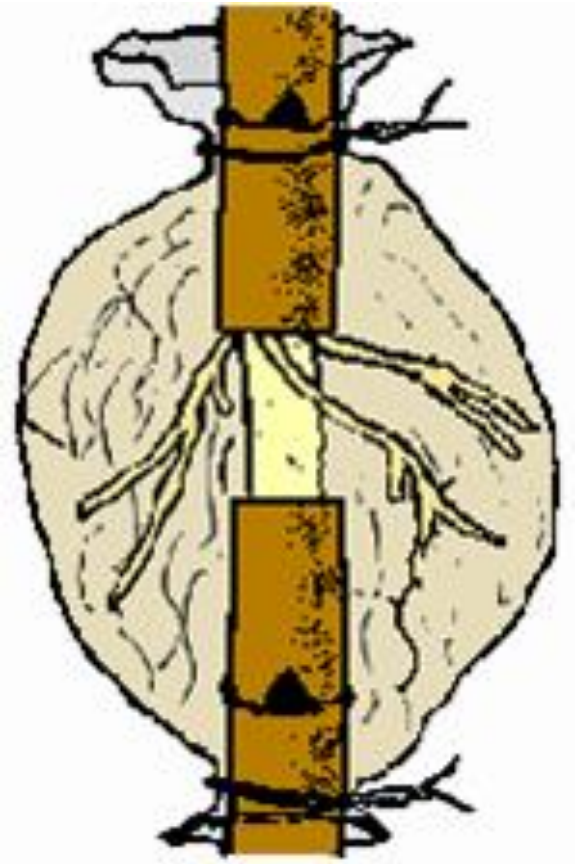
Mound Layering

- Rooted plant is cut off at the soil level.
- As the season progresses, soil is added to cover the growing shoots.
- After 1 year, the shoots are rooted and removed from the parent plant.

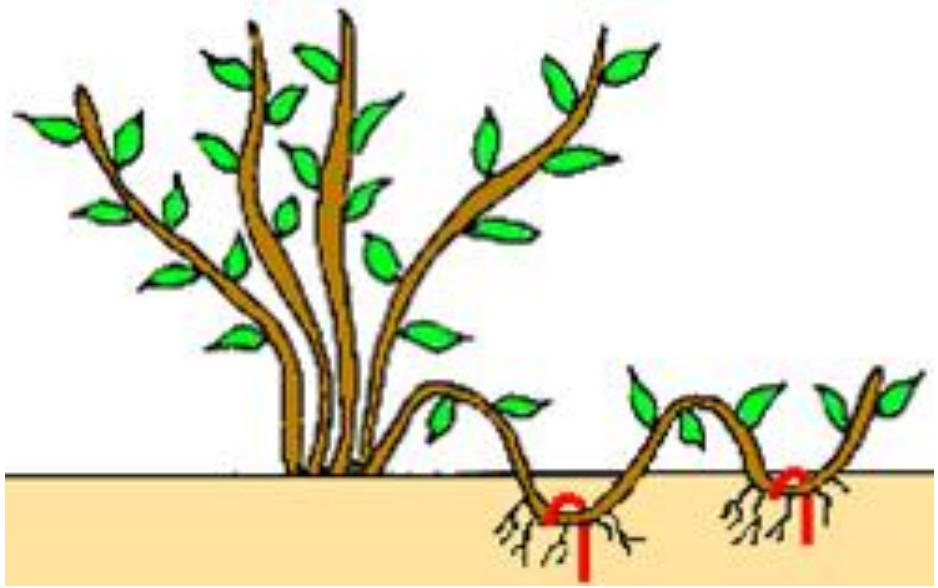


Air Layering

- Also called Chinese propagation.
- Area of plant is girdled and surrounded by a moist growing medium that is sealed in polyethylene film.



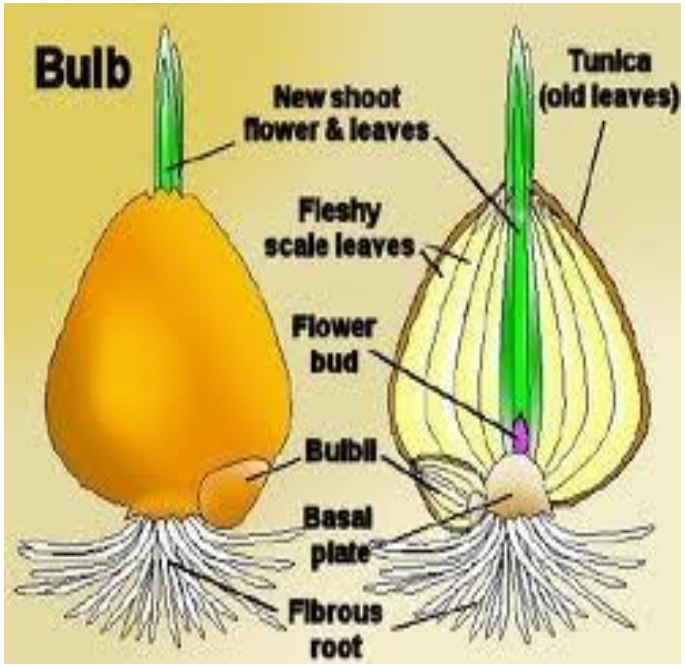
Compound Layering



Division & Separation

- Cutting or pulling apart of….
  - Bulbs
  - Corms
  - Rhizomes
  - Tubers
  - Runners
  - Stolens
  - Suckers

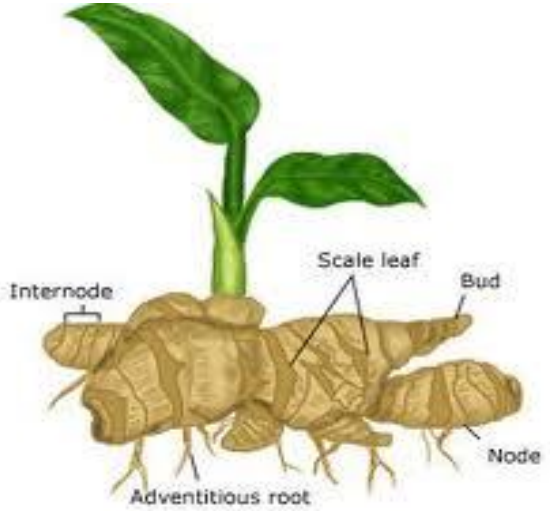
Separation


Bulb
New shoot
flower & leaves
Tunica
(old leaves)
Fleshy
scale leaves
Flower
bud
Bulbil
Basal
plate
Fibrous
root


Lily bulb
bulb scales

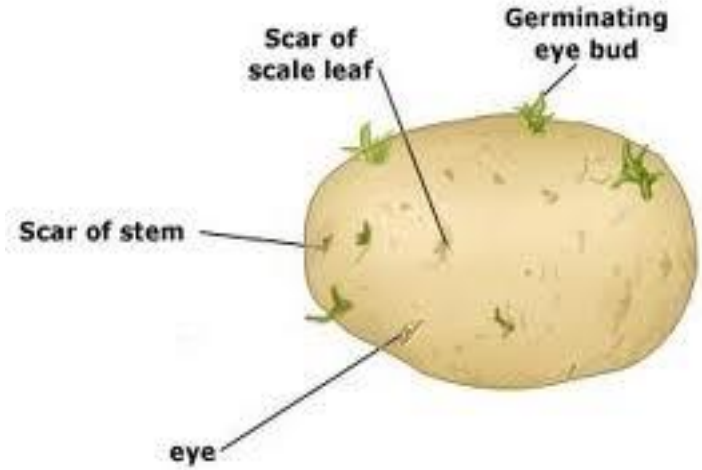
Corm

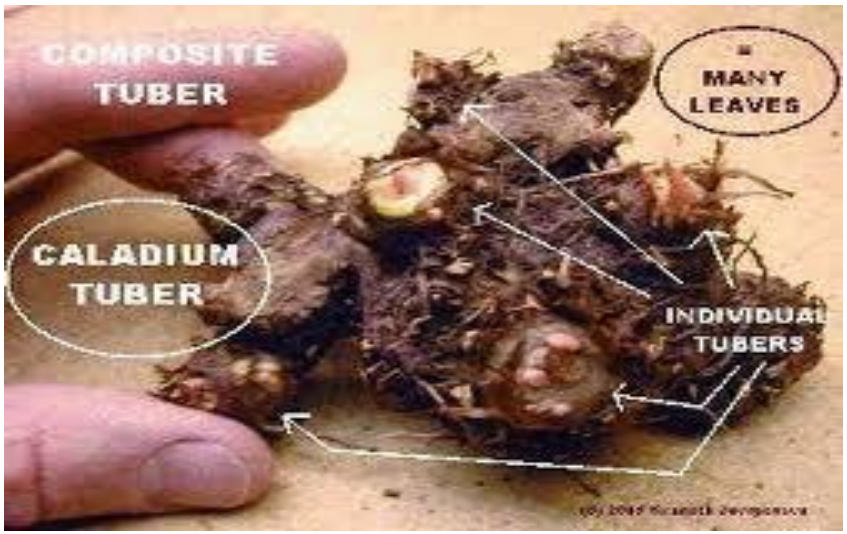
Rhizome



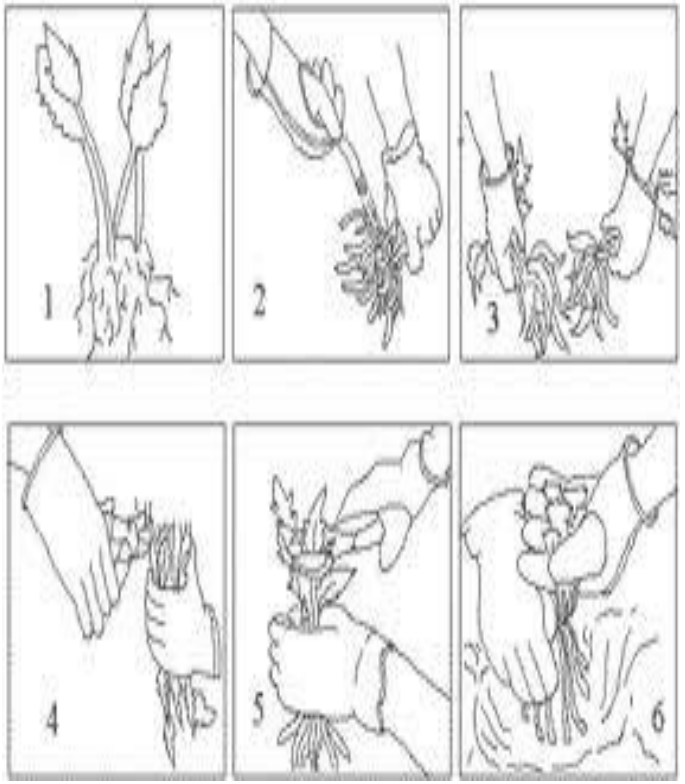
Offset (Offshoot)

Tuber


Scar of scale leaf
Germinating eye bud
Scar of stem
eye


COMPOSITE TUBER
MANY LEAVES
CALADIUM TUBER
INDIVIDUAL TUBERS

Crown



Rooting from Cuttings

- Rooting media should be about 4 inches deep.
- Best time of day to take cuttings is early morning because plants have more moisture.

Rooting from Cuttings

- The three main types of cuttings are….
  - Stem
  - Leaf
  - Root

Stem Cuttings

- The taking of a piece of stem to reproduce plants.
- Use a rooting hormone with fungicide to….
  - Speed up root development.
  - Prevent root rot.

Types of Stem Cuttings

Segments of stems containing buds are used to produce new plants. There are several types:

- **Softwood**
- **Semi-hardwood**
- **Hardwood**
- **Herbaceous**

- **<u>Softwood cuttings</u> are taken from woody plants when growth is still relatively soft and succulent before tissues have matured and become woody.**

- Softwood cuttings usually root easier and faster than other types of stem cuttings, taking about 6 weeks. Softwood cuttings should be taken during the summer months when plants are still growing. The stems should be hardened enough to “snap” when bent.

- **<u>Semi-hardwood cuttings</u> differ from softwood cuttings only in the maturity of the wood. They are collected later in the growing season when the lower portion of the cutting has become lignified (woody).**

- Semi-hardwood cuttings of evergreen species are generally taken from new shoots 6 to 9 weeks after a flush of growth when the wood is partially matured. This can be any time from mid-spring to the end of the growing season.

- **<u>Hardwood cuttings</u> are taken in the dormant season when tissues are fully matured and lignified through their entire length. This may be after leaves have dropped in deciduous species.**

- Cuttings should be planted upright with the top 2 – 3 buds above the medium. Hardwood cuttings vary in length from 4 to 20 inches with at least two nodes included in the cutting. The diameter of the cutting may range from ¼ to 1 inch depending upon the species.

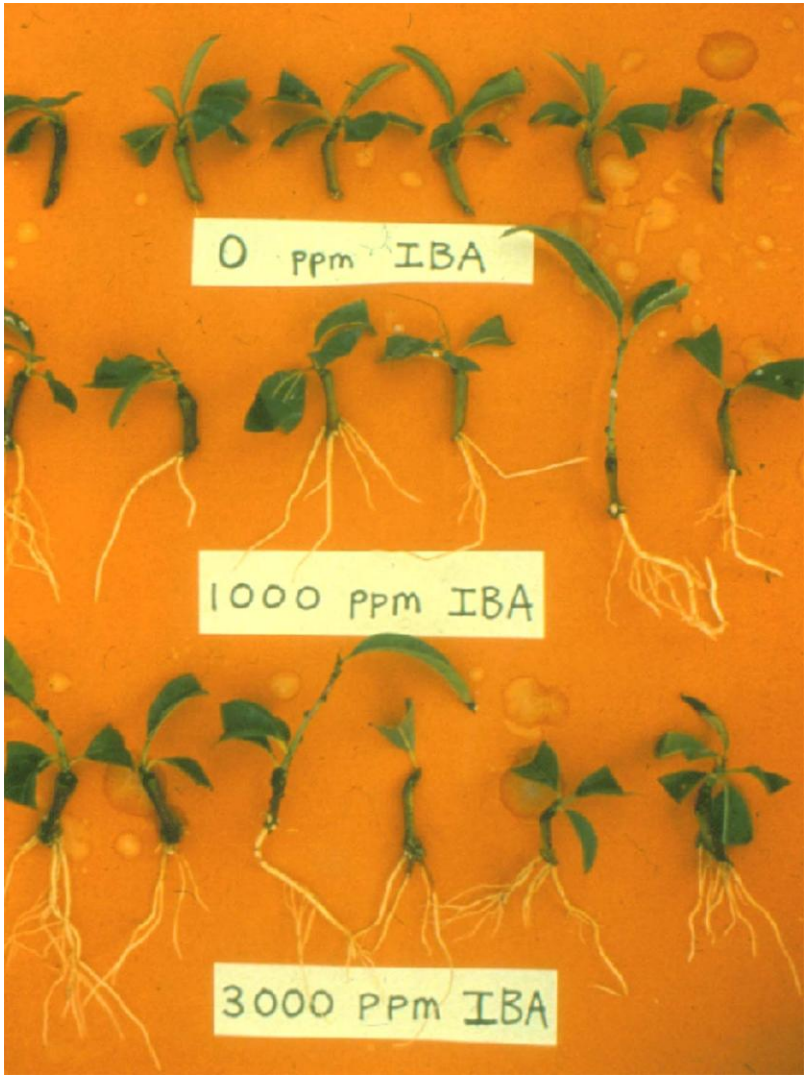
- **<u>Herbaceous cuttings</u> are made from succulent, herbaceous (non-woody) plants such as geraniums, chrysanthemums, coleus, and carnations.**

- Herbaceous cuttings are typically 3 to 5 inches in length with leaves retained at the upper end. Most florists' crops are propagated by herbaceous cuttings.

Softwood Cuttings-Peach

- **Actively growing shoots are used**

- **Softwood cuttings are taken during spring and summer**



Leaf Cuttings

- The use of leaves and sections of leaves to reproduce plants.
- Done from herbaceous plants.
- Veins must be cut!!!

Single Node Cuttings

Double-Eye Single Node Cutting (DE)

- Healthier than SE
- Less disease attacks

Single-Eye Single Node Cutting (SE)

- Largest no. cuttings/plant
- Slower development
- Higher mortality

Root Cuttings

- The use of roots to reproduce plants.
- Should be spaced 3 inches apart in the rooting area.

Procedure

- Gather Materials
- Prepare Rooting Media
- Remove Cuttings from Stock
- Prepare Cuttings
- Apply Rooting Hormone
- Place Cuttings in Media
- Label Cuttings
- Follow Proper Safety and Sanitation Procedures

Many types of media may be used for rooting beds including sand, perlite, pine bark and vermiculite or a combination of these products. Vermiculite, shown here, makes a good rooting media because of its coarse texture, sterile nature and water and air holding capacities.

Rooting media should be firmed so cuttings make good contact with the media and to eliminate large air pockets. Firming can be accomplished with clean hands, a piece of wood or by tapping the container on the bench. The media should also be thoroughly moistened.

Many propagators take large pieces of stock from the field and move to an indoor location for final cutting preparation and sticking. In this case, place cuttings in a plastic bag and keep the cuttings out of the sunlight.

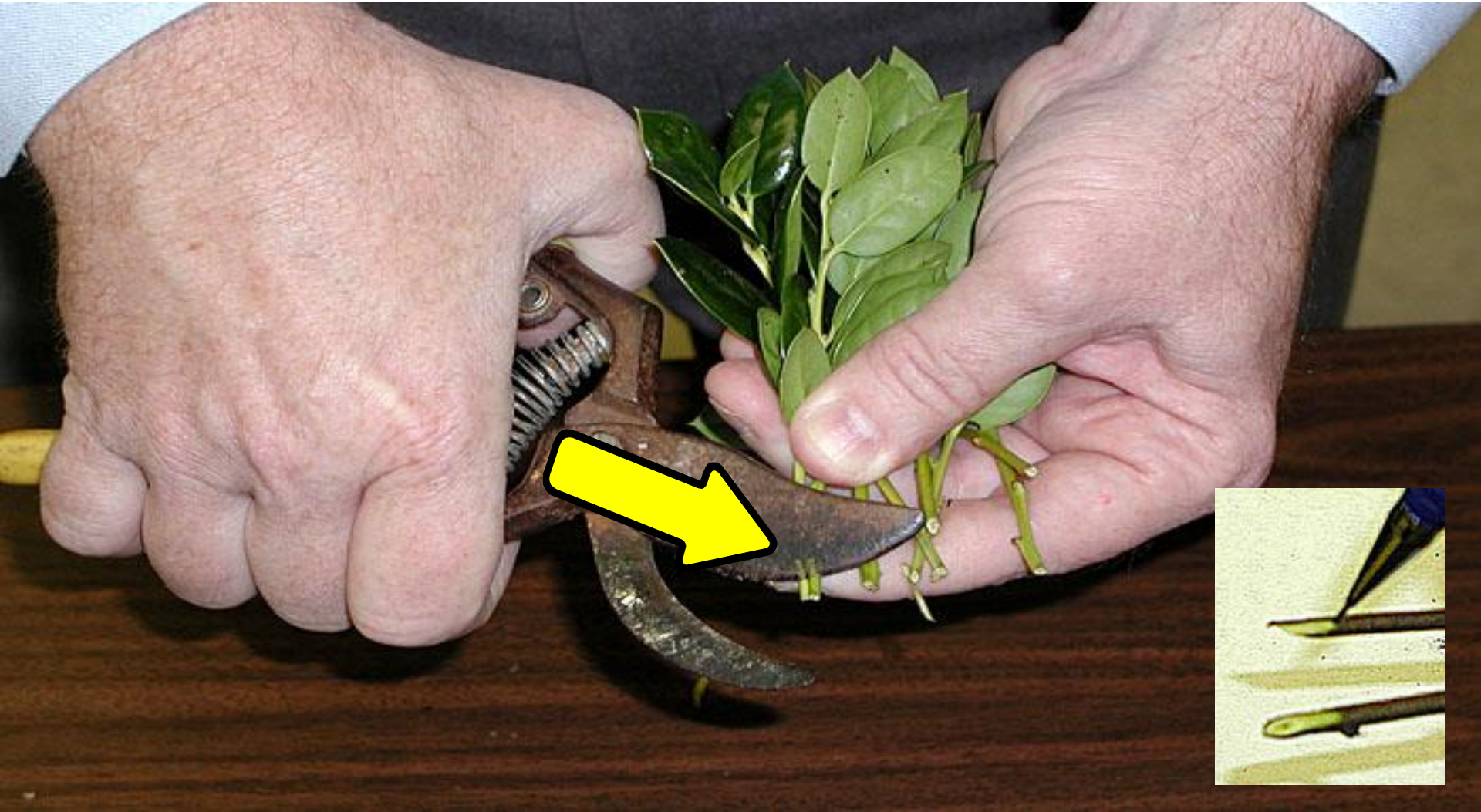
Select quality stock. Avoid stems with flowers and berries.

Make a basal cut just below a node at a 45 degree angle.

Cuttings should be 3” to 6” long, and uniform in size, although larger or smaller cuttings are used in certain situations. Cutting size is limited because the top of the cutting must be supported by the limited amount of moisture that can be absorbed through the base until rooting takes place.

Remove the bottom leaves from the cuttings. Leaves placed under the soil or in direct contact with the media may rot and cause disease.

Cuttings of harder-to-root plants are often wounded to expose more cambium and increase the chances of rooting while decreasing the time required to root.



The leaves of large-leaved cuttings may be trimmed before sticking to conserve propagation space.

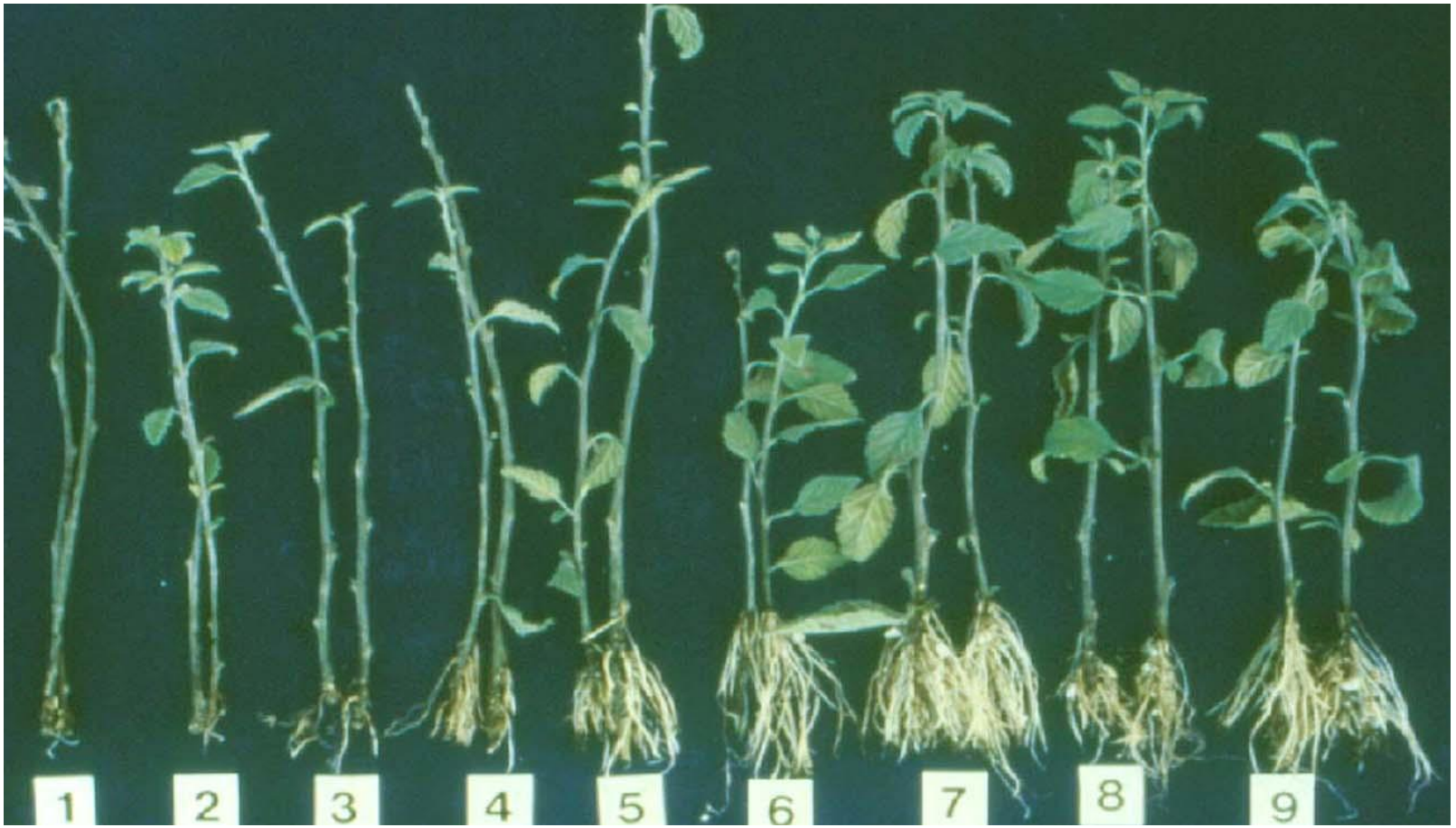
Treating cuttings in IBA Solution (top)

Sticking IBA-treated cuttings in root substrate (bottom)

Semi-Hardwood Cuttings - Jojoba

Tap off the excess hormone powder. Be sure that the portion of the stem that will be under the media is coated.

Influence of IBA on Semi-Hardwood Cuttings - Cordia



***1*-Control, *2*-50% ethanol, *3*-100 ppm, *4*-1000 ppm, *5*-2000 ppm, *6*-4000 ppm, *7*-6000 ppm, *8*-8000 ppm, *9*-10000 ppm IBA**

Make holes in the growing media with a label or other clean tool.

Place cuttings into the media 1 to 2 inches deep. Hold each cutting with your fingers at the desired depth and push the cutting into the prepared hole or furrow until the desired depth is reached. Placing all cutting at the same depth helps in establishing uniformity.

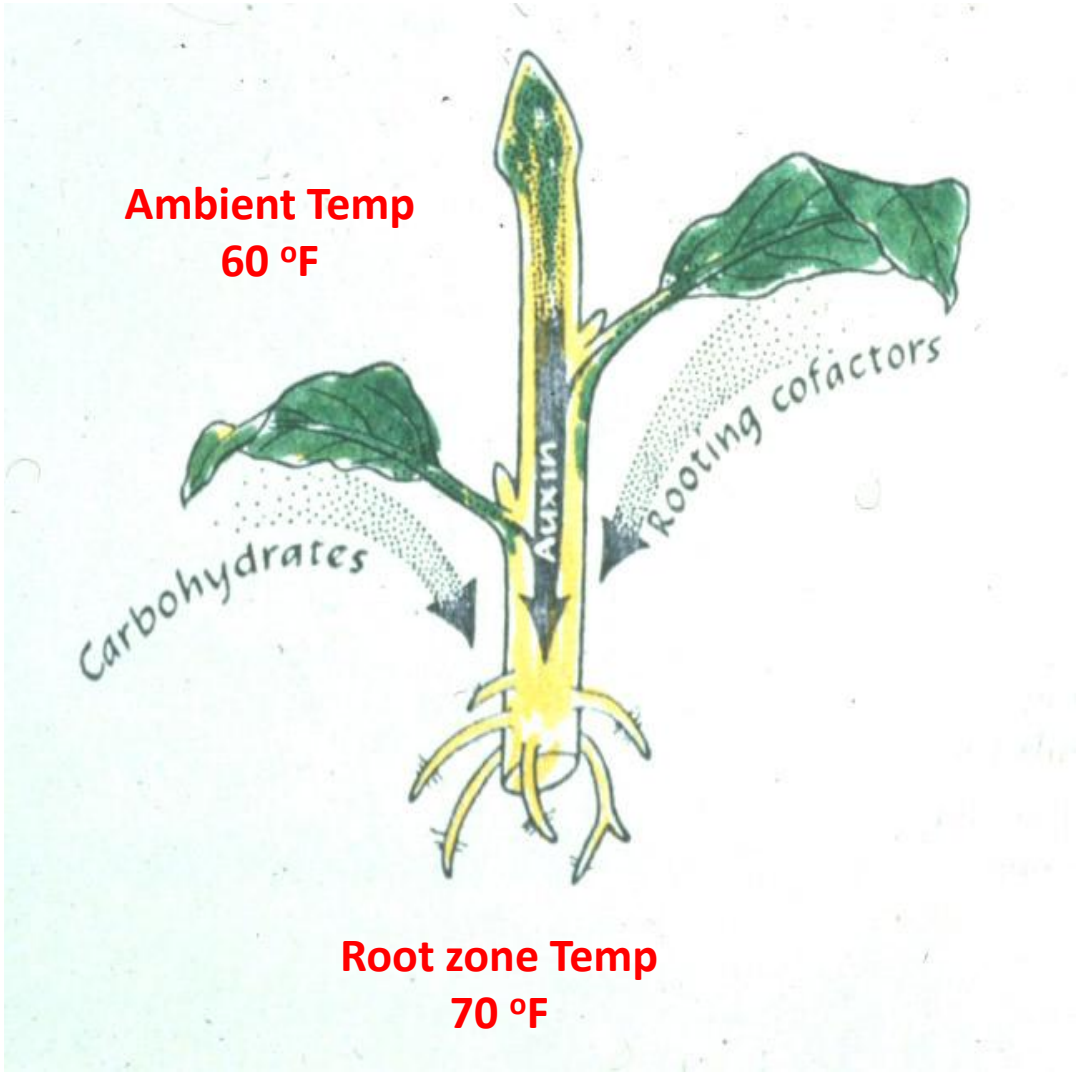
The cuttings can also be firmed using a label or other clean tool.

To test for proper firmness of the media around the base of the cutting, give a light tug on the cutting. If the cutting slips easily from the media with little resistance, the cutting was not firmed properly.

Cuttings placed too close together, with overlapping leaves, hold moisture and prevent air circulation, allowing disease organisms to thrive.

Place the label in the container with the plant name facing out for easy identification.

Temperature Differential Helpful for Root Formation



- Rooting requires carbohydrates (energy), auxin (growth hormone), and rooting cofactors (enzymes)

- Temperature differential (10 °F) between the ambient air and root zone is helpful for faster rooting

Bottom Heat System for Cutting Benches

Safety and Sanitation Procedures

NEVER cut toward hand or fingers!

Pruning shears should be closed when not in use.

Proper sanitation is essential to prevent disease. Alcohol or a 10% bleach solution may be used.

Discard remaining rooting hormone to prevent the spread of disease. DO NOT contaminate the main supply by returning used hormone to the original container.

DO NOT

use cutting materials that are dropped on the floor. The dropped materials may become contaminated with disease and infect the entire crop. Keep work areas neat, clean and free of debris.

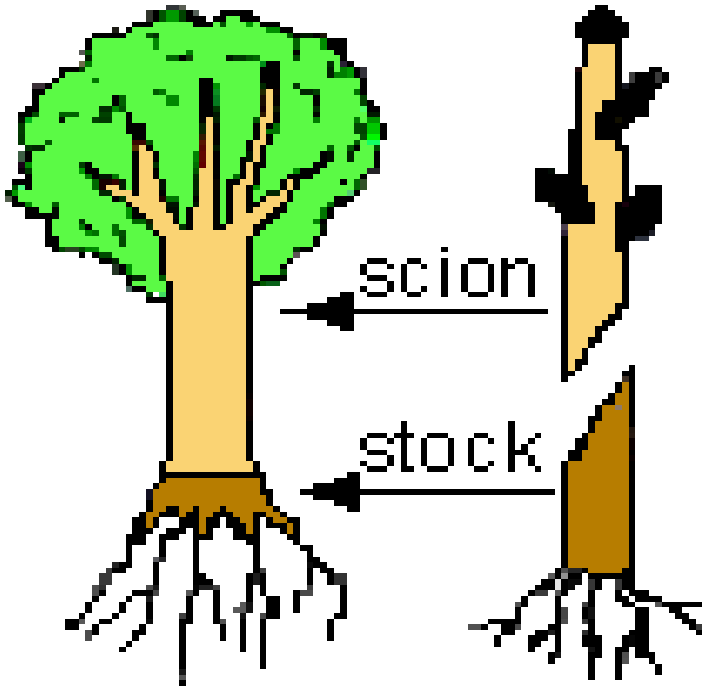
Good sanitation is important

Cutting on the left was infected with Alternaria and did not root

Cutting on the right was healthy and rooted well

Grafting

- Joining separate plant parts together so that they form a union and grow together to make one plant.
- Scion
  - Piece of plant at the top of the graft.
- Rootstock
  - The piece of the plant at the or bottom of the graft.



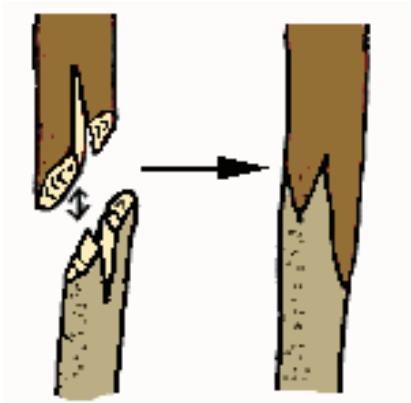
Grafting Methods

- Scion & rootstock are the same size:
  - Wedge
  - Splice
  - Whip & tongue
  - Approach

Grafting Methods

- Scion is smaller than the rootstock:
  - Cleft.
  - Side.
  - Notch.
  - Bark inlay.

Grafting Methods



whip & tongue graft

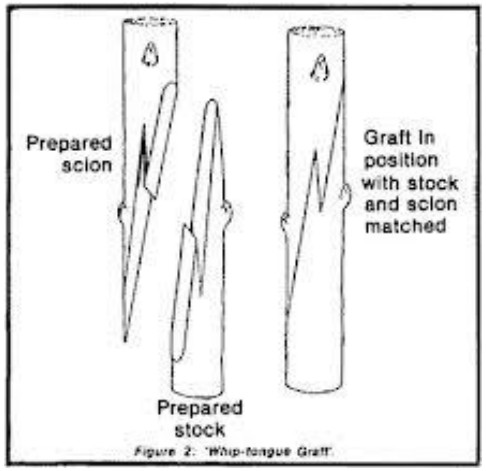
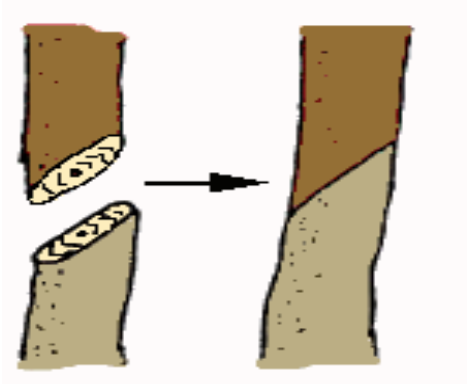
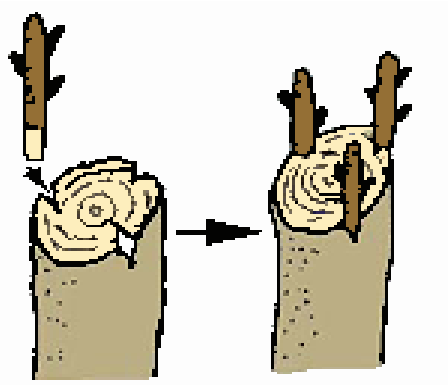


Figure 2: 'Whip-tongue Graft'

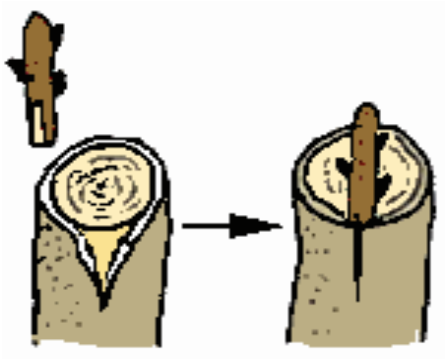


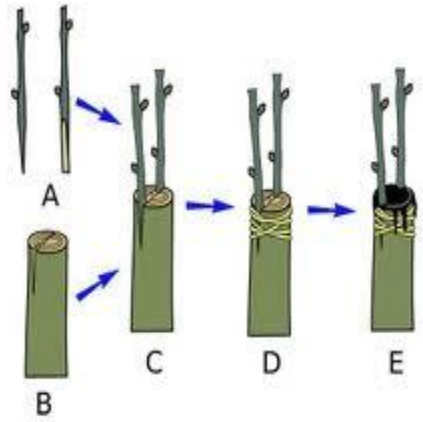
splice graft



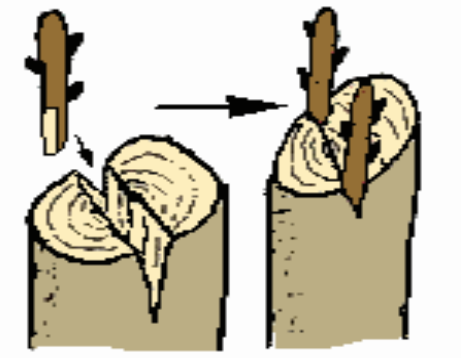
notch graft

Fig. 2.—Triangular Notch-grafting.

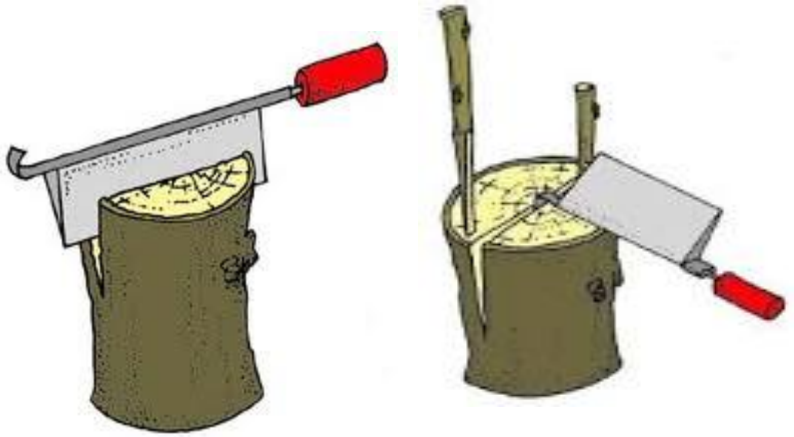




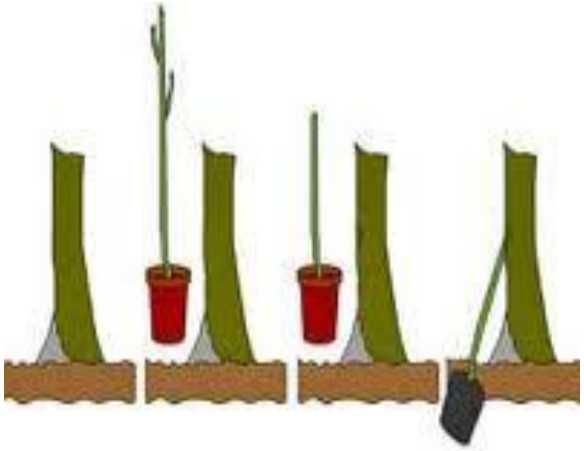
bark inlay graft



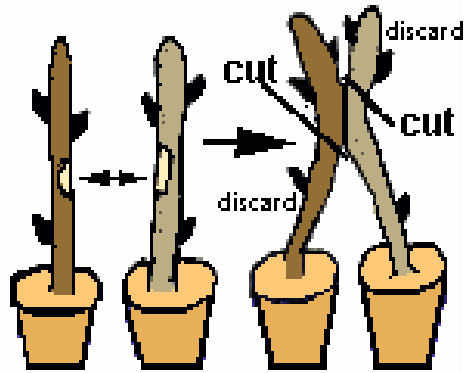
cleft graft



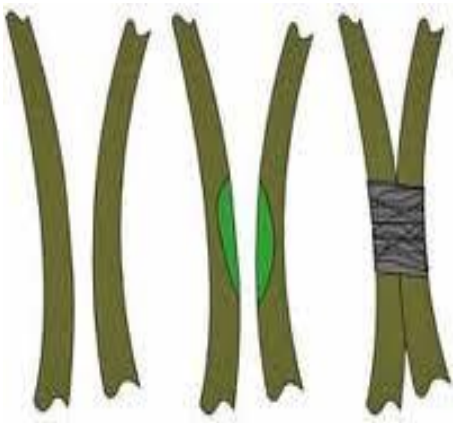
Bridge graft



Inarching graft



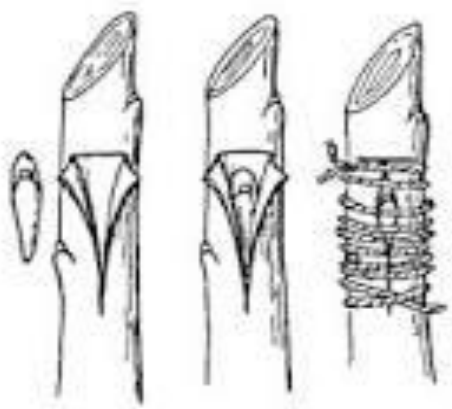
approach graft



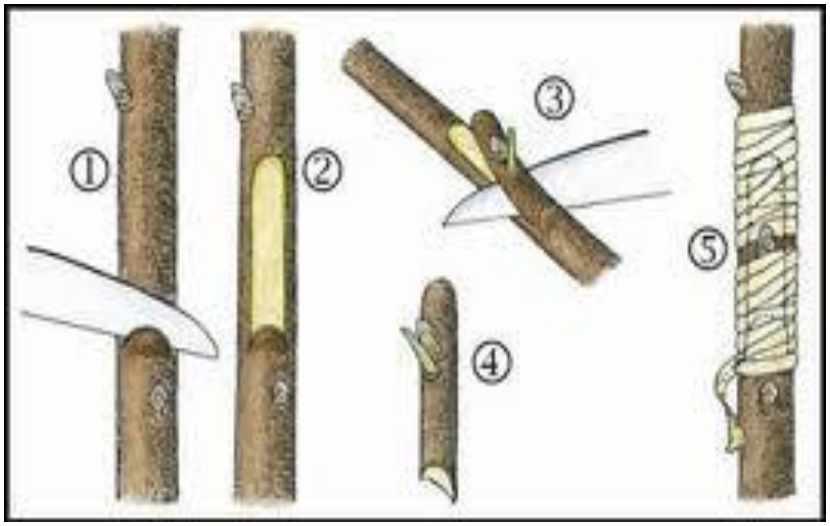
Budding

- A form of grafting when a bud is used.
- Faster or quicker than grafting.
- The 3 main methods are….
  - Patch budding.
  - T-budding.
  - Chip budding.

T-Budding



Chip Budding

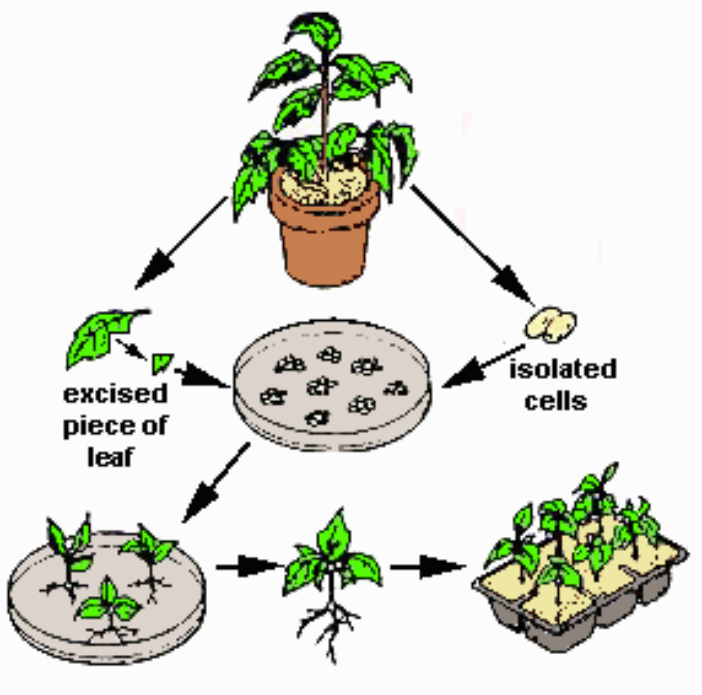


Patch Budding

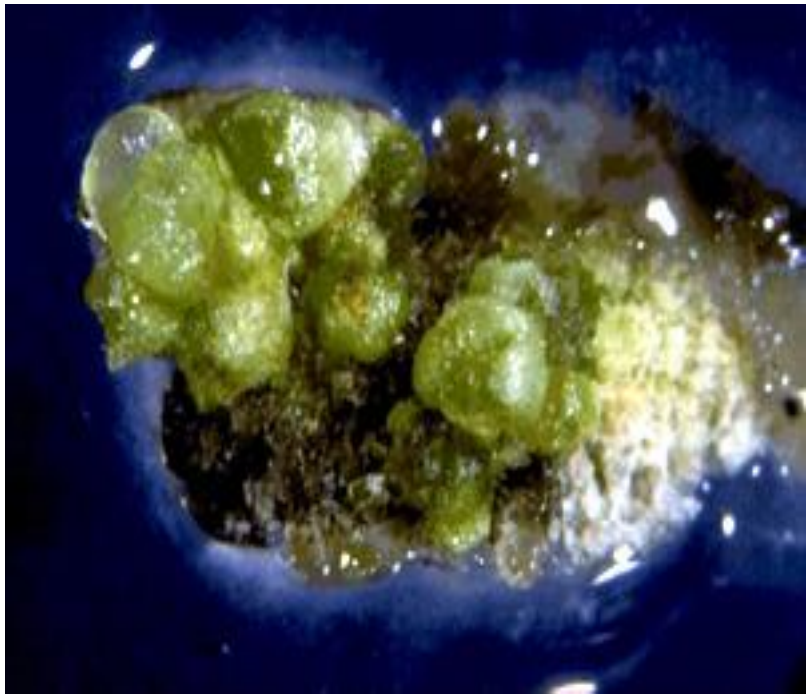
Tissue Culture

- Must have a sterile environment.
- Get the most plants in a short time.
- True to parent plants.

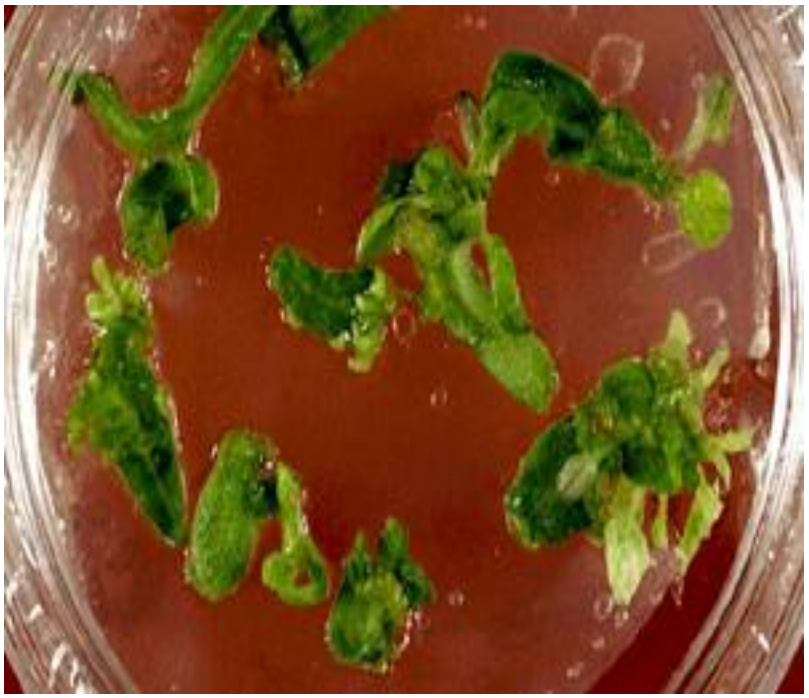
Tissue culture (often called **micropropagation**) is a special type of asexual propagation where a very small piece of tissue (shoot apex, leaf section, or even an individual cell) is excised (cut-out) and placed in sterile (aseptic) culture in a test tube, petri dish or tissue culture container containing a special culture medium.



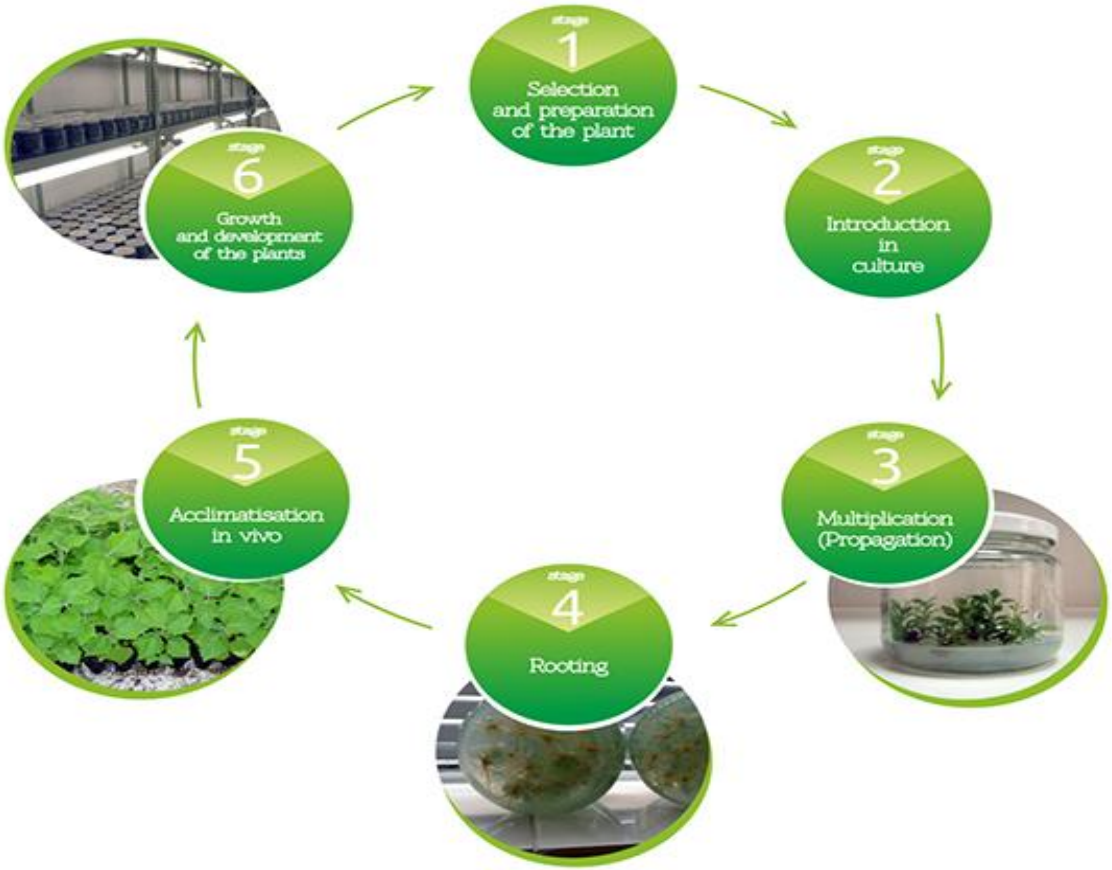
- The **culture medium** contains a gel (agar) with the proper mixture of nutrients, sugars, vitamins and hormones, which causes the plant part to grow at very rapid rates to produce new plantlets. It has been estimated that one chrysanthemum apex placed in tissue culture could produce up to 1,000,000 new plantlets in one year. Thus, tissue culture is used for rapid multiplication of plants. A very specialized laboratory is required for tissue culture. All the procedures are done in a laboratory and special ventilated cabinet that is as sterile as an operating room.



A mass of callus tissue is formed that is just starting to make new plantlets.



New plantlets (shoots with leaves) are forming.


stage 1
Selection and preparation of the plant
stage 2
Introduction in culture
stage 3
Multiplication (Propagation)
stage 4
Rooting
stage 5
Acclimatisation in vivo
stage 6
Growth and development of the plants

Advantages to Asexual Propagation

- Plants mature in shorter time.
- Some plants do not produce viable seeds.
- New plants are same as parent plant.

Disadvantages to Asexual Propagation

- Some methods require special equipment & skills….
  - Such as grafting.
- Cuttings detach plant parts from water and nutrient source.
- Some plants are patented….
  - Making propagation illegal.

Biotechnology in Horticulture

Methods of Biotechnology

- Genetic Engineering
  - Movement of genetic information in the form of genes from one cell to another cell to modify or change the genetic make-up.

Benefits of Biotechnology

- Produce many identical plants in a short time.
- Increase disease and insect resistance.
- Increase tolerance to heat or cold.
- Increase weed tolerance.
- Increase tolerance to drought.
- Improve environment.
- Increase production.
- Other genetic changes.