

Propagation in Horticultural Plants

Asexual propagation

Asexual propagation, sometimes referred to as vegetative propagation, involves taking vegetative parts of a plant (stems, roots, and/or leaves) and causing them to regenerate into a new plant or, in some cases, several plants. With few exceptions, the resulting plant is genetically identical to the parent plant. The major types of asexual propagation are cuttings, layering, division, separation, grafting, budding, and micropropagation.

Advantages of asexual propagation include:

- It may be easier and faster than sexual propagation for some species.
- It may be the only way to perpetuate particular cultivars.
- It maintains the juvenile or adult characteristics of certain cultivars.
- It allows propagation of special types of growth, such as weeping or pendulous forms.
- It may more quickly result in a large plant (compared to one propagated by seed).
- A form of asexual reproduction in plants, in which multicellular structures become detached from the parent plant and develop into new individuals that are genetically identical to the parent plant.

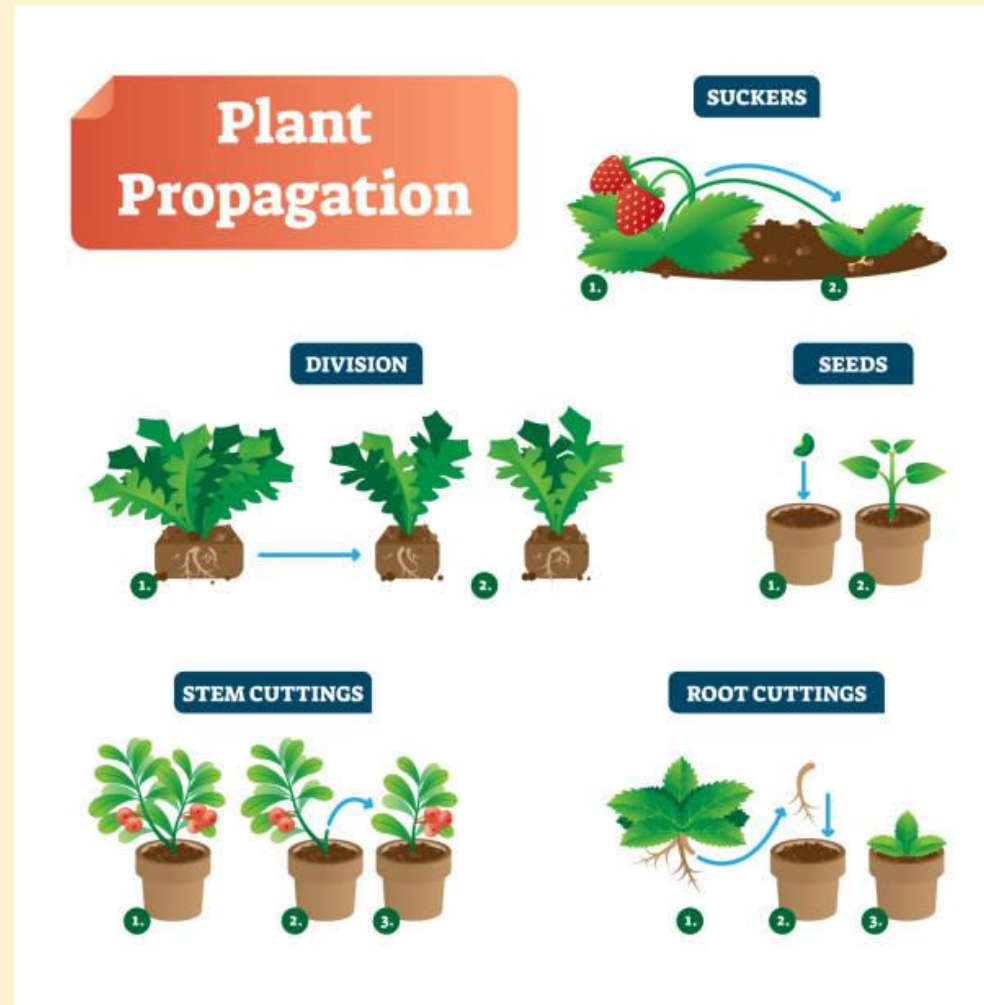
Vegetative Propagation

Using plant cuttings to reproduce plants from existing plants.



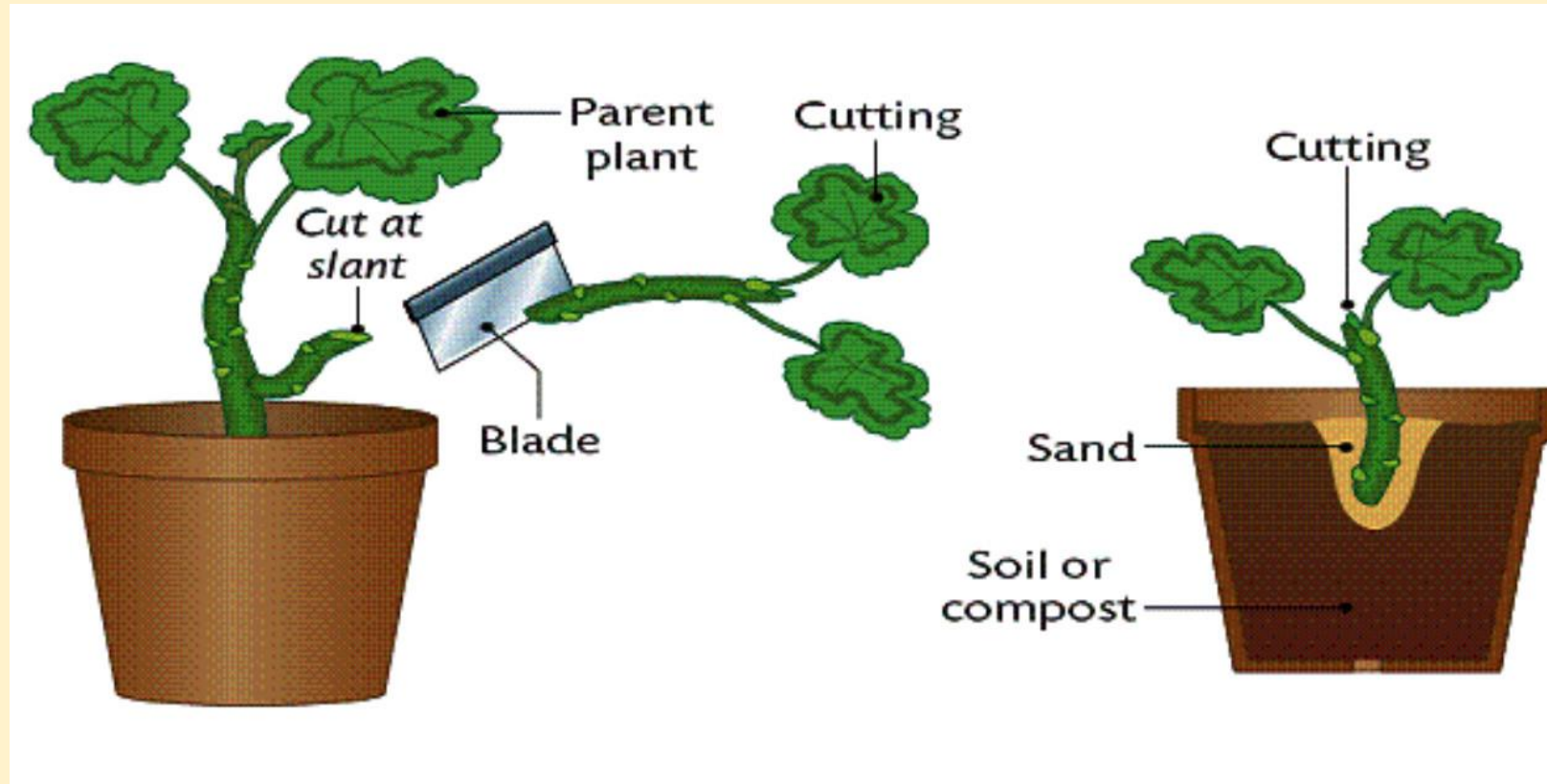
Asexual Propagation

Asexual propagation is the process of taking vegetative pieces of a desirable plant and reproducing new plants from these tissues. Asexual propagation permits cloning of plants, meaning the resulting plants are genetically identical to the parent plant. The major methods of asexual propagation are cuttings, layering, division, separation, budding, grafting, and micropropagation (tissue culture).



Cuttings

Propagation by cuttings involves rooting a severed piece of the parent plant or, in some cases, producing new plants from severed pieces of tissue (leaf cuttings). A greenhouse is not necessary for successful propagation by cuttings.



If rooting only a few cuttings, you can use a flowerpot or small flat maintain high humidity by covering the cuttings with a bottomless milk jug or by placing the container into a clear plastic bag. Cuttings can also be placed in plastic trays covered with clear plastic stretched over a wire frame.

Containers must have holes in the bottoms for drainage. The plastic helps keep the humidity high and reduces water loss from the plant. If a more elaborate structure is needed, construct a small hoop frame or use an intermittent mist system.

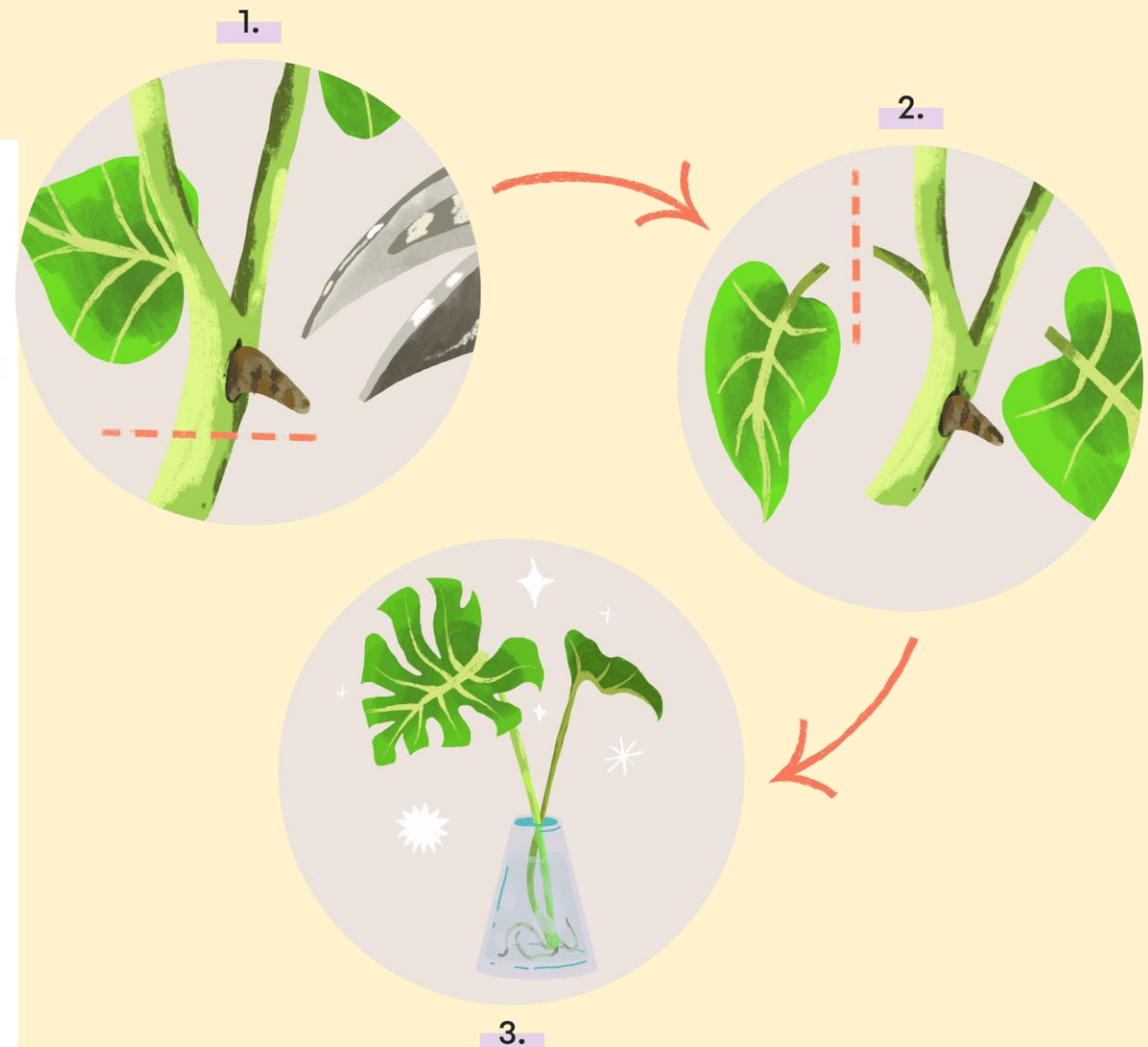
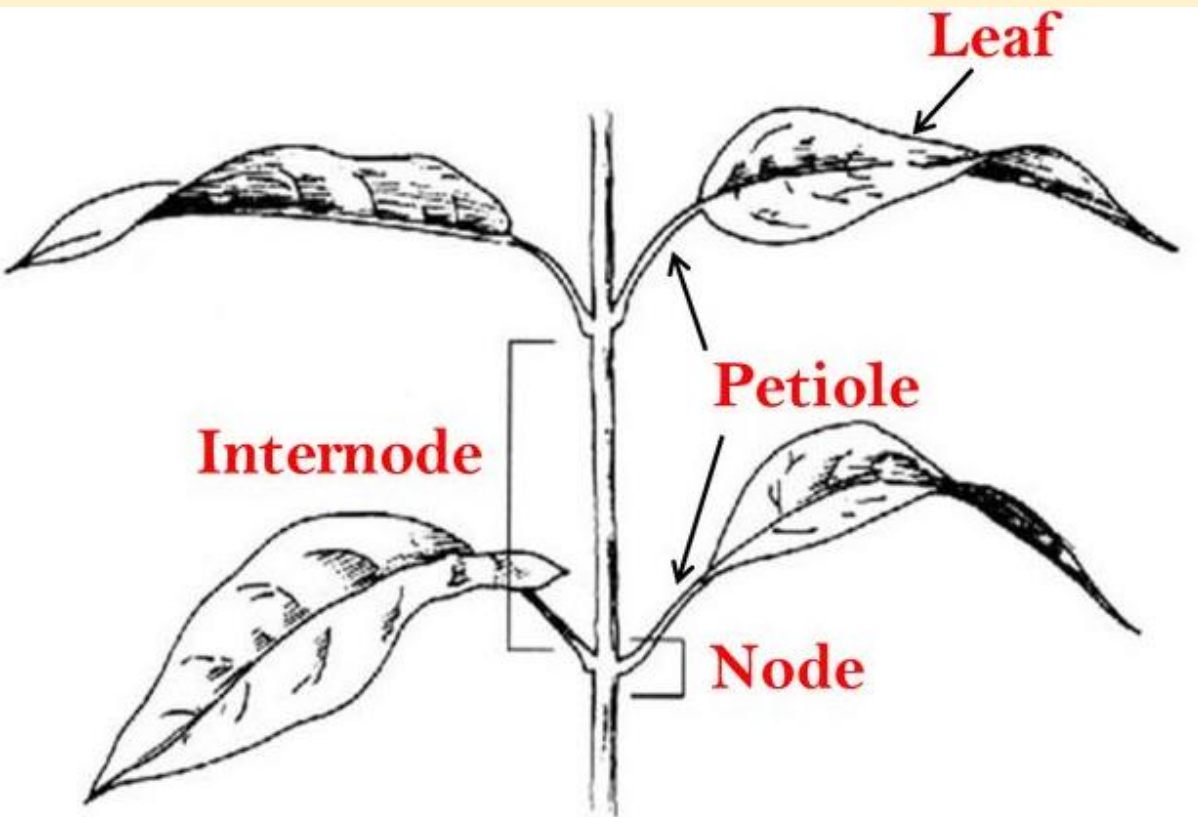
The rooting medium should be sterile, low in fertility, well drained to provide sufficient aeration, and moisture-retentive so that watering does not have to be done too frequently. Materials commonly used are coarse sand, a mixture of one part peat and one or two parts perlite (by volume), or one part peat and one part sand (by volume). Various commercial potting media may also be used. Vermiculite by itself is not recommended because it packs and tends to hold too much moisture. Media should be watered well before use.

There are several different kinds of cuttings. Which type you use depends on the kind of plant and, often, the plant's growth stage.

Some plants can be propagated from only a leaf, but most plants produce only a few roots or simply decay. Because leaf cuttings do not include an axillary bud, they can be used only for plants that are capable of forming adventitious buds. Leaf cuttings are used almost exclusively for propagating some indoor plants.

Leaf Cuttings

Leaf petiole—Remove a leaf and include up to 1½-inches of the petiole. Insert the lower end of the petiole into the medium. One or more new plants form at the base of the petiole. The leaf may be severed from the new plants—when they have their own roots—and then reused. Examples of plants that can be propagated by this method include African violet, peperomia, episcia, hoya, and sedum.



Leaf Cuttings

Leaf without a petiole—This method is used for plants with thick, fleshy leaves. The snake plant (*Sansevieria trifasciata*), a monocot, can be propagated by cutting the long leaves into 3-inch to 4-inch pieces). Insert the cuttings vertically into the medium. African violets (dicot) can also be propagated this way. Cut a leaf from a plant and remove the petiole. Insert the leaf vertically into the medium, making sure that the midvein is buried in the rooting medium. New plants form from the midvein.



Leaf cutting with petiole.



Leaf cutting without petiole.

Leaf Cuttings



Leaf cutting that has rooted. Used leaf with petiole.



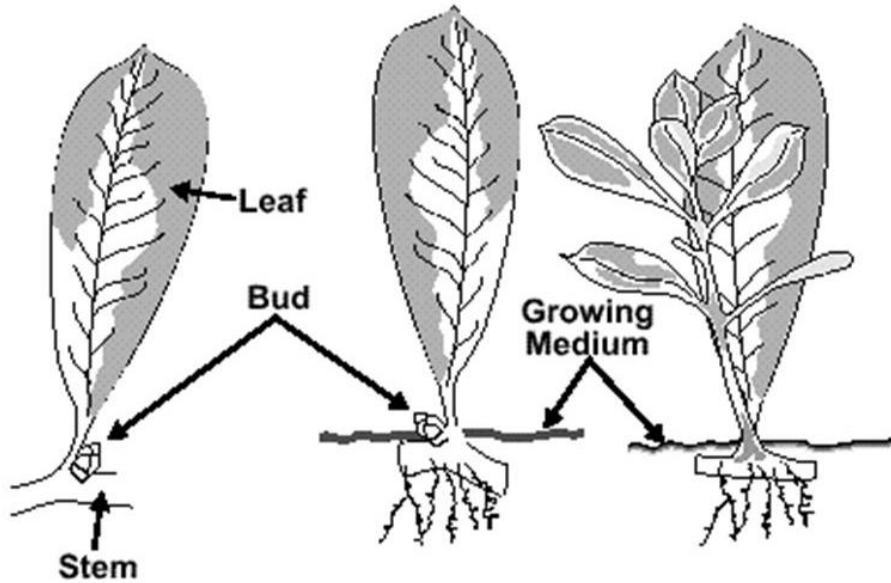
Leaf Cuttings

Split-vein—Detach a leaf from the plant and remove the petiole. Make cuts on several prominent veins on the underside of the leaf. Lay the cutting, lower side down, on the medium. New plants form at each cut. If the leaf curls up, hold it in place by covering the margins with rooting medium. A variation of this method is to cut the leaf into wedges so that each piece has a main vein.



Leaf-Bud Cuttings

Leaf-bud cuttings are used for many trailing vines and when space or cutting material is limited. Each node on a stem can be treated as a cutting. The cutting consists of a leaf blade, petiole, and a short piece of stem with an attached [axillary bud](#). Place cuttings in the medium with the bud covered (to 1 inch) and the leaf exposed. A modified version of a leaf-bud cutting, referred to as a single node cutting, can be prepared simply by cutting the stem below and above the leaf petiole having a well-developed axillary bud. Examples of plants propagated this way include blackberry, camellia, clematis, devil's ivy, dracaena, grape ivy, heart-leaf philodendron, jade plant, mahonia, rhododendron, and rubber plant.



Cane Cuttings

A cane cutting is an easy way to propagate some overgrown, leggy houseplants such as dumbcane, corn plant, Chinese evergreen, and other plants with thick stems. Leafless stem sections (2 to 3 inches long) are cut from older stems. Each cane should contain one or two nodes. Lay the cutting horizontally on the medium, or insert it vertically with about half of the cutting below the surface of the medium, and leave a bud facing upward. Cane cuttings are usually potted when roots and new shoots appear.



Stem Cuttings

Propagation by stem cuttings is the most commonly used method for many woody ornamental plants. Typically, stem cuttings of tree species are more difficult to root successfully; however, cuttings from trees such as crape myrtles, some elms, and birches can be rooted.



Types of Stem Cuttings

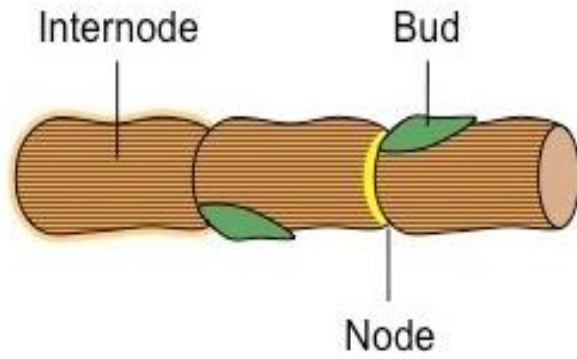
The four main types of stem cuttings are herbaceous, softwood, semi-hardwood, and hardwood. These terms reflect the growth stage of the stock plant, which is one of the most important factors influencing whether cuttings produce roots. Calendar dates are useful only as guidelines.

Herbaceous cuttings are made from nonwoody, herbaceous plants. A 3-inch to 5-inch piece of stem is cut from the parent plant. The leaves on the lower one-third to one-half of the stem are removed, and the cutting is placed in the rooting medium. A high percentage of the cuttings root, and they do so quickly.

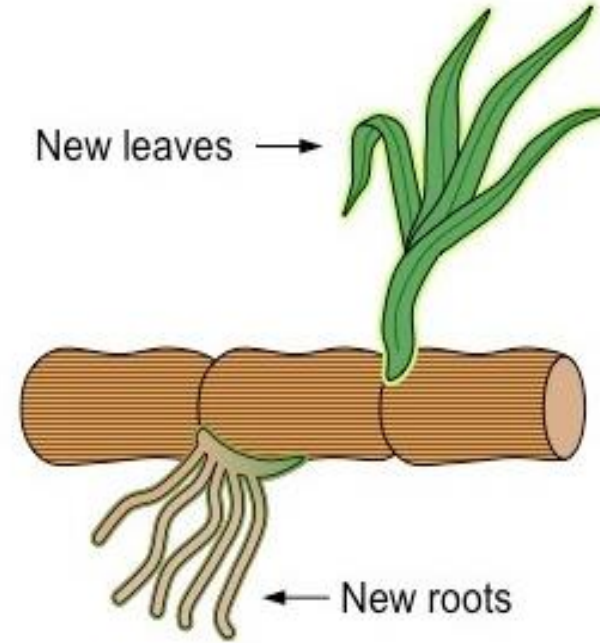
Softwood cuttings are prepared from soft, succulent, new growth of woody plants, just as it begins to harden (mature). Shoots are suitable for making softwood cuttings when they can be snapped easily when bent and when they still have a gradation of leaf size (oldest leaves are mature whereas newest leaves are still small). For most woody plants this stage occurs in May, June, or July. The soft shoots are quite tender, and extra care must be taken to keep them from drying out. The extra effort pays off, though, because they root quickly.

Semi-hardwood cuttings are usually prepared from partially mature wood of the current season's growth, just after a flush of growth. This type of cutting normally is made from mid-July to early fall. The wood is reasonably firm and the leaves of mature size. Many broadleaf evergreen shrubs and some conifers are propagated by this method.

Hardwood cuttings are taken from dormant mature stems in late fall, winter, or early spring. Plants are generally fully dormant with no obvious signs of active growth. The wood is firm and does not bend easily. Hardwood cuttings are most often used for deciduous shrubs but can be used for many evergreens. Examples of plants propagated at the hardwood stage include fig, forsythia, grape, privet, and spirea. The three types of hardwood cuttings are straight, heel, and mallet. A straight cutting is the most commonly used stem cutting. For the heel cutting, a small section of older wood is included at the base of the cutting. For the mallet cutting, an entire section of older stem wood is included.



Stem Cutting

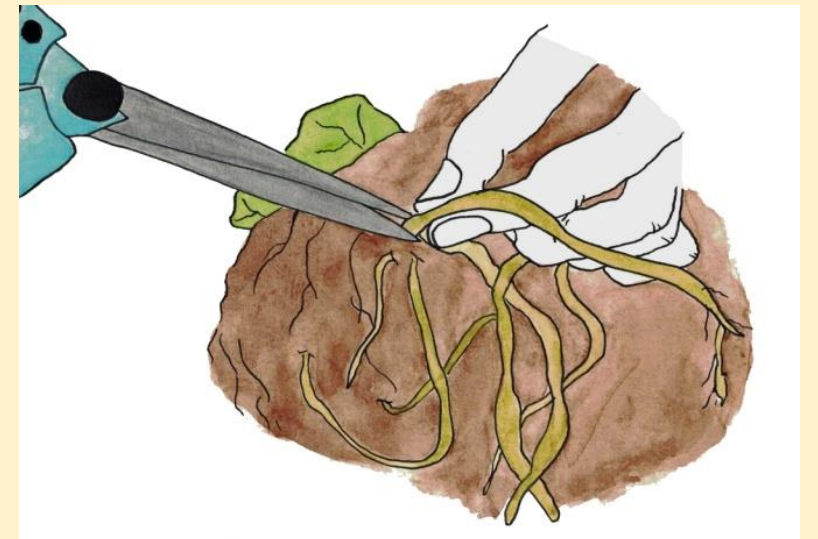


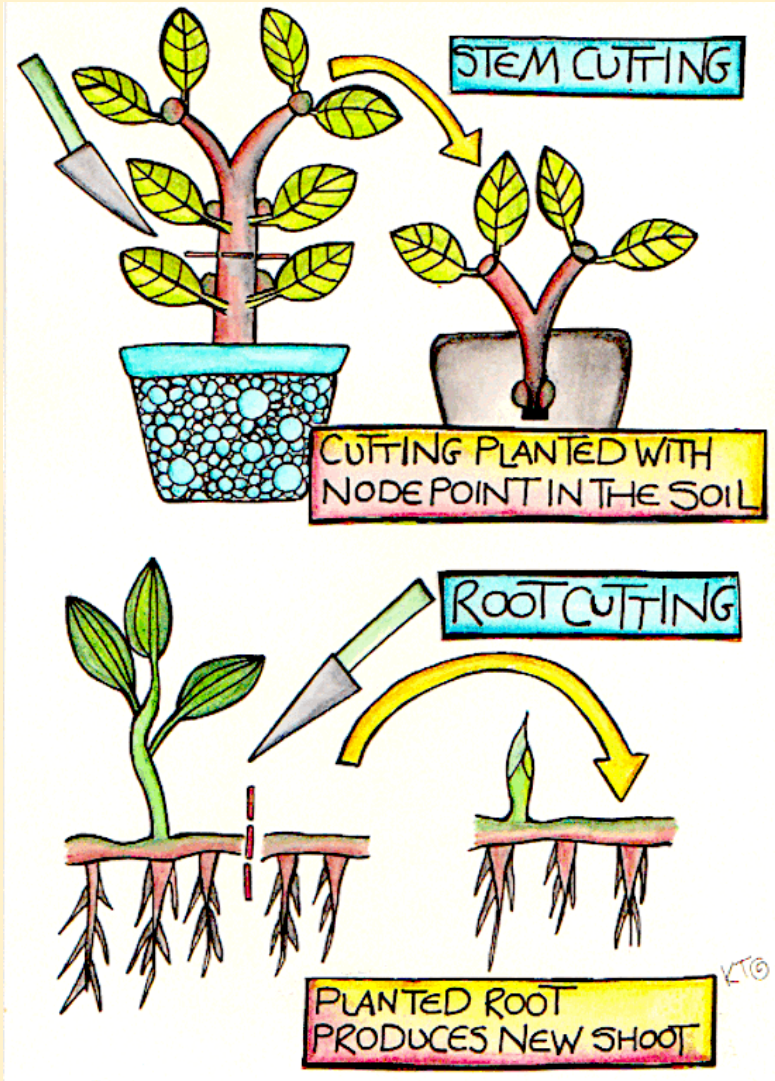
Rooting of stem cutting

Root Cuttings

Some plants can be propagated from a section of a root. Root cuttings are usually taken from 2- to 3-year-old plants during the dormant season when carbohydrate levels are high. Root cuttings of some species produce new shoots, which then form their own root system, whereas root cuttings of other plants develop root systems before producing new shoots. Examples of plants that can be propagated from root cuttings include blackberry, apple, fig, lilac, phlox, raspberry, rose, sumac, and trumpet vine.

Plants with large diameter roots are normally propagated outdoors. The root cuttings should be 2 to 6 inches long. Make a straight cut on the proximal end (nearest the crown of the parent plant) and a slanted cut on the distal end (farthest from the crown) of each root cutting. Tie the cuttings in bundles with all the same ends together. It is important to maintain the correct polarity of the cuttings. Store about three weeks in moist sawdust, peat moss, or sand at 40°F. Remove from storage. Plant the cuttings distal end pointed down, about 2 to 3 inches apart in well-prepared garden soil. The tops of the cuttings (proximal ends) should be the shallowest part of the planting at 2 to 3 inches below the soil surface. For plants with small diameter roots, cut the roots into 1-inch to 2-inch sections. Lay the cuttings horizontally on the medium surface in a flat and cover with about ½-inch of soil or sand. Place the flat inside a plastic bag or cover with a pane of glass. Place the flat in the shade and remove the protective cover after new shoots appear.



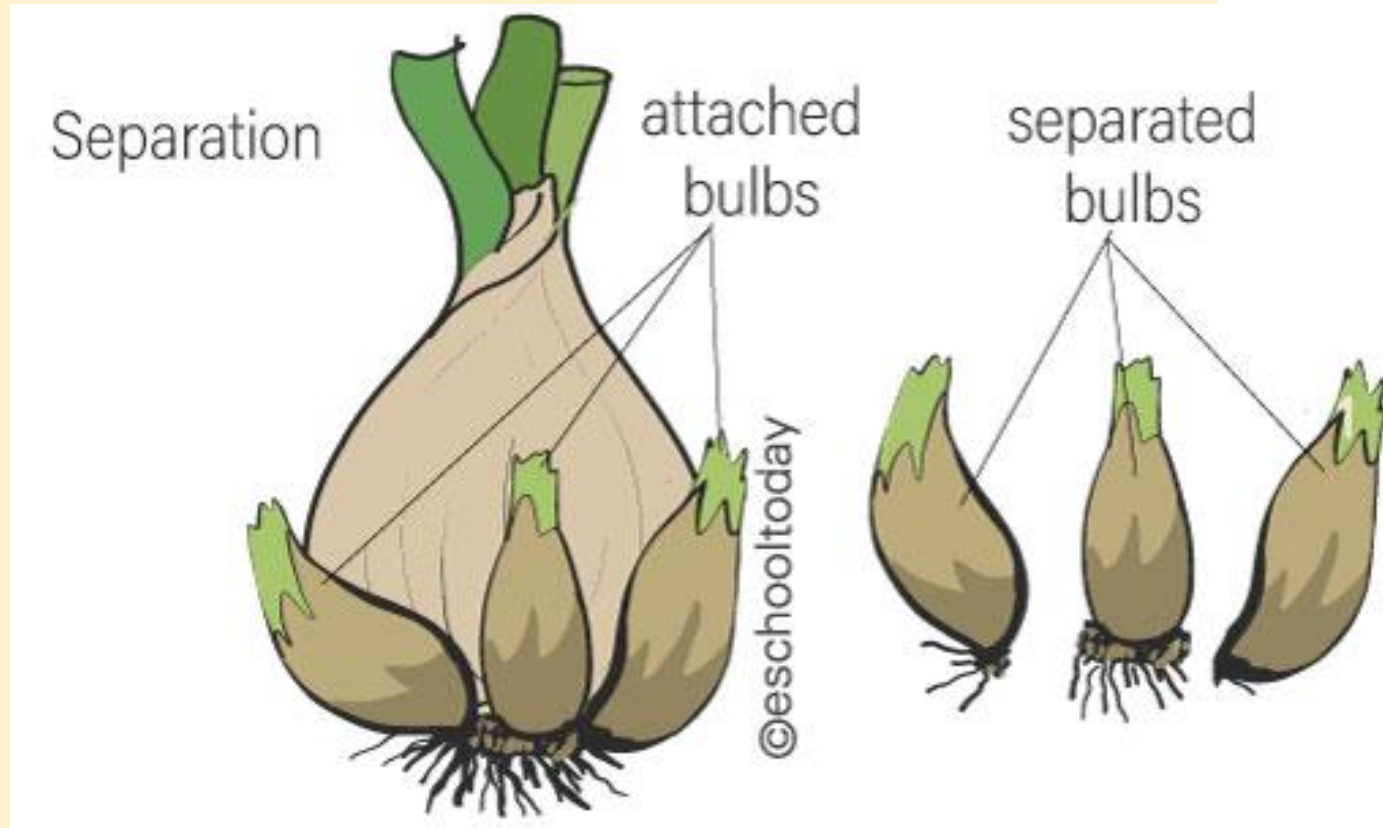


What are separation and division?

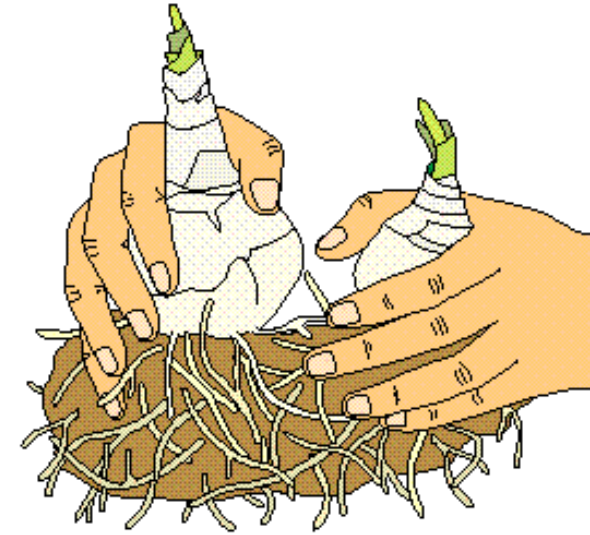
- Propagation of horticulture crops can be done by separating or dividing plants.
- These are common methods used with perennials and foliage plants.
- Some woody shrubs can be divided as well.
- Some plants produce vegetative plant structures that can be removed intact from the parent plant.
- Removal and planting of these vegetative structures is separation.
- With division, the plant roots or the entire plant may be cut into sections to make two or more plants from the original plant.

Separation

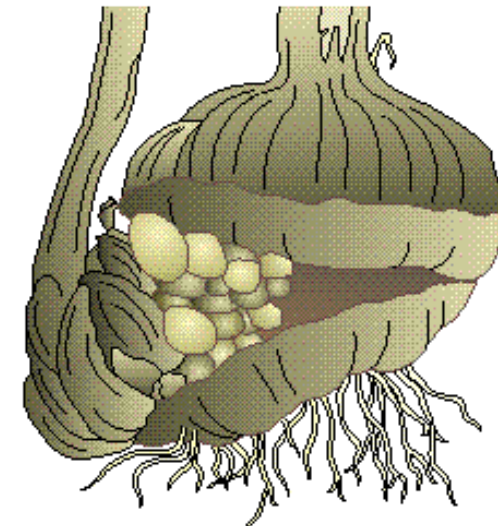
Method in which natural structures are removed from the parent plant and planted to grow.



SEPARATION OF BULBS AND CORMS



Bulbs



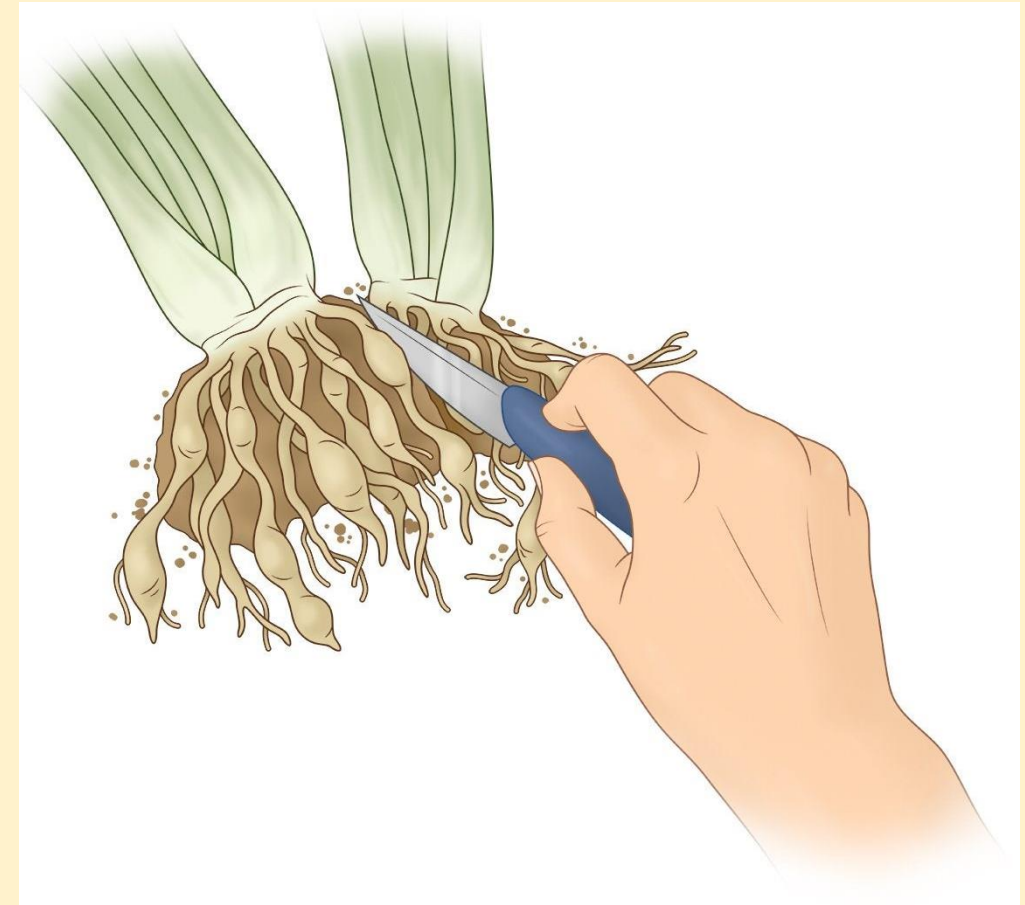
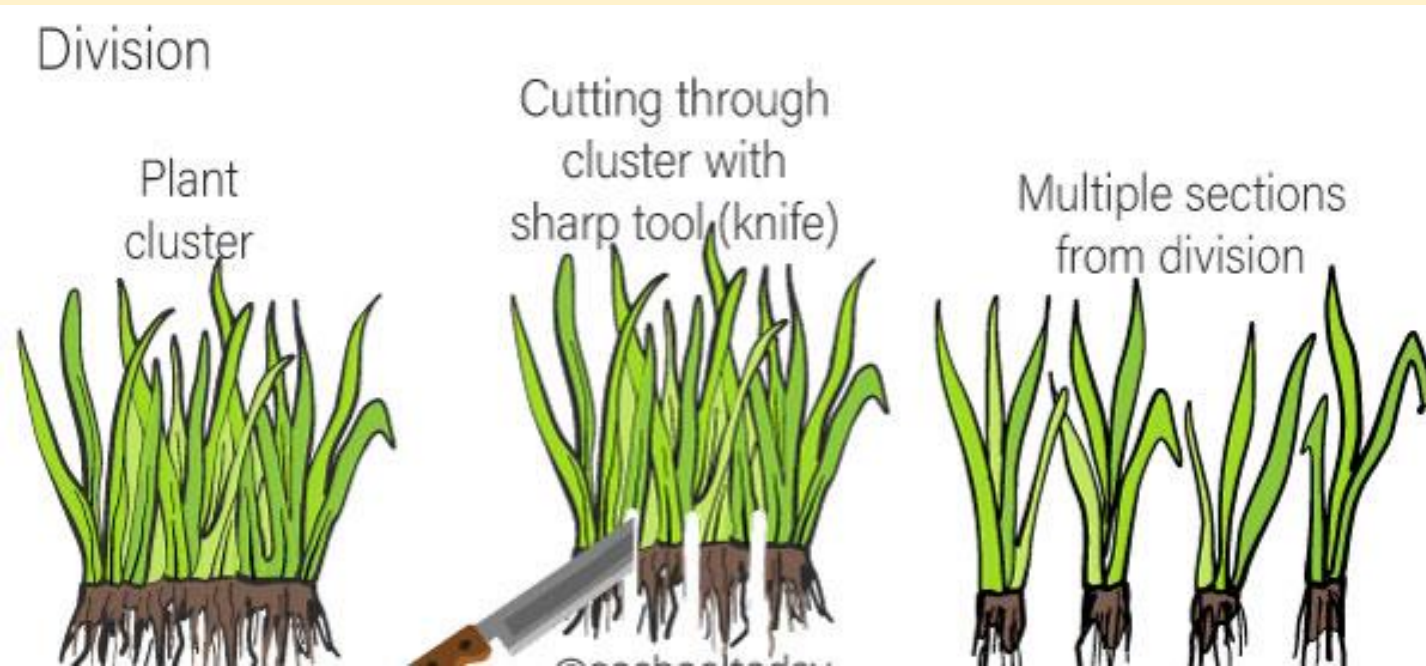
Corms

Division

Method in which parts of plants are cut into sections that will grow naturally into new plants.

Plant structures that can be separated or divided include:

- bulbs
- corms
- rhizomes and tubers
- plant crowns



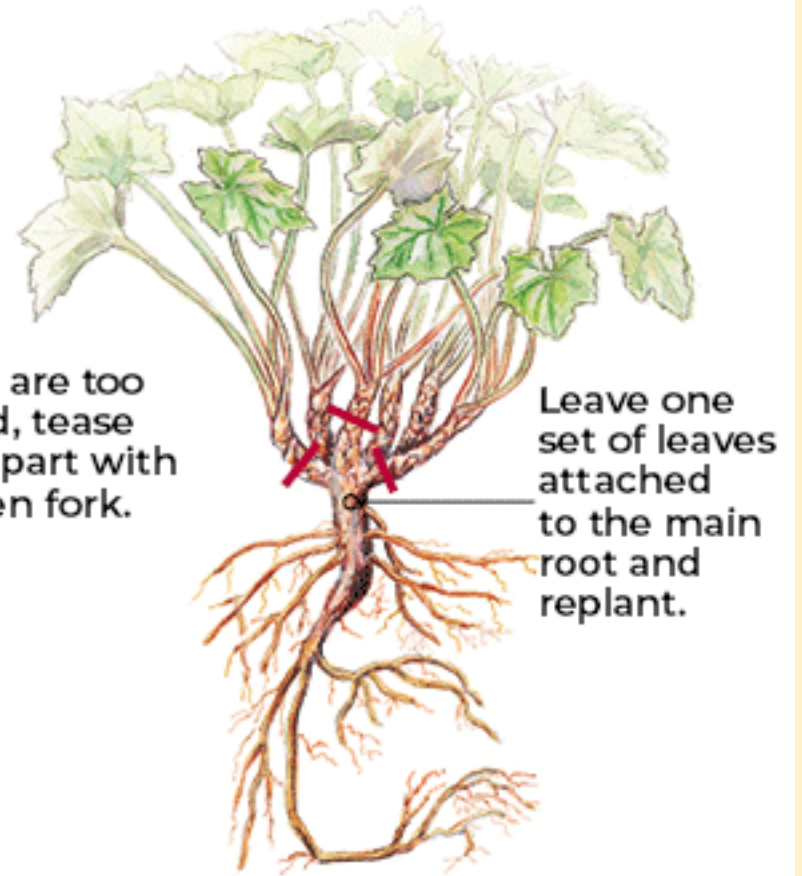
RHIZOMES

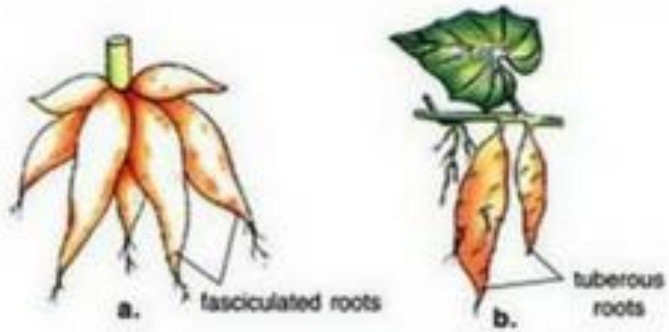


CLUMP

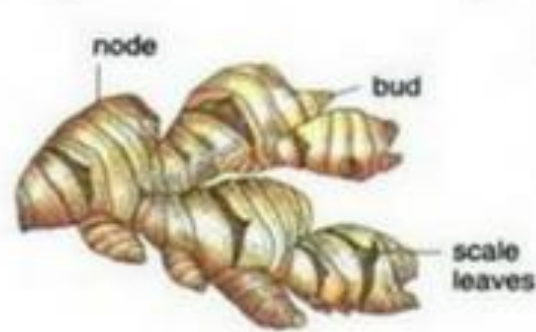


WOODY CROWNS

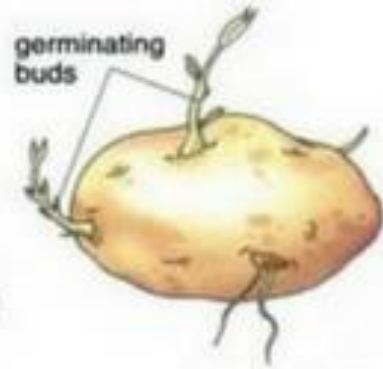




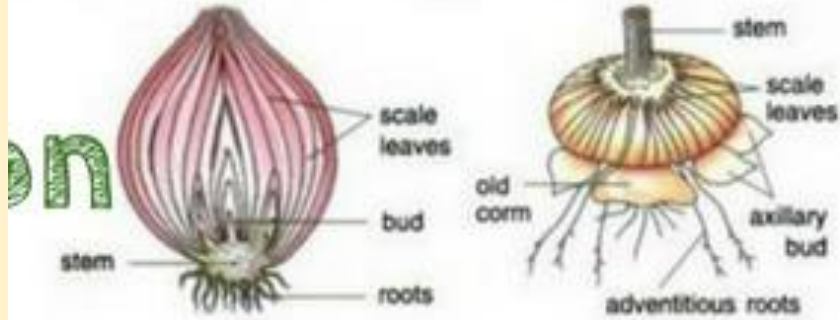
Vegetative propagation by roots of *Dahlia* and sweet potato



Vegetative propagation by rhizome in ginger

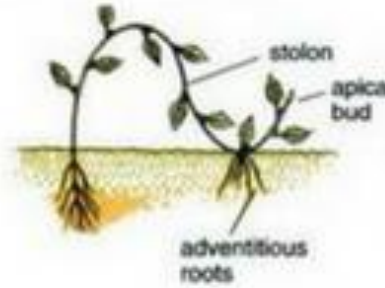


Vegetative propagation by tuber in potato

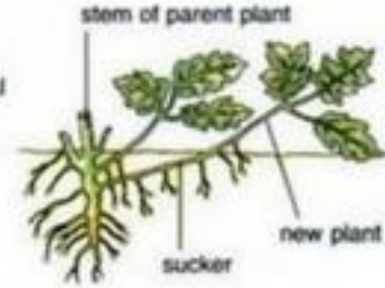


Vegetative propagation by bulb in onion

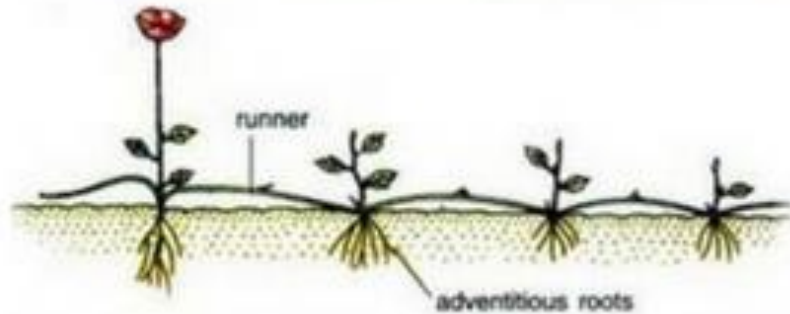
Vegetative propagation by corm in *Gladiolus*



Vegetative propagation by stolon



Vegetative propagation by sucker in *Chrysanthemum*



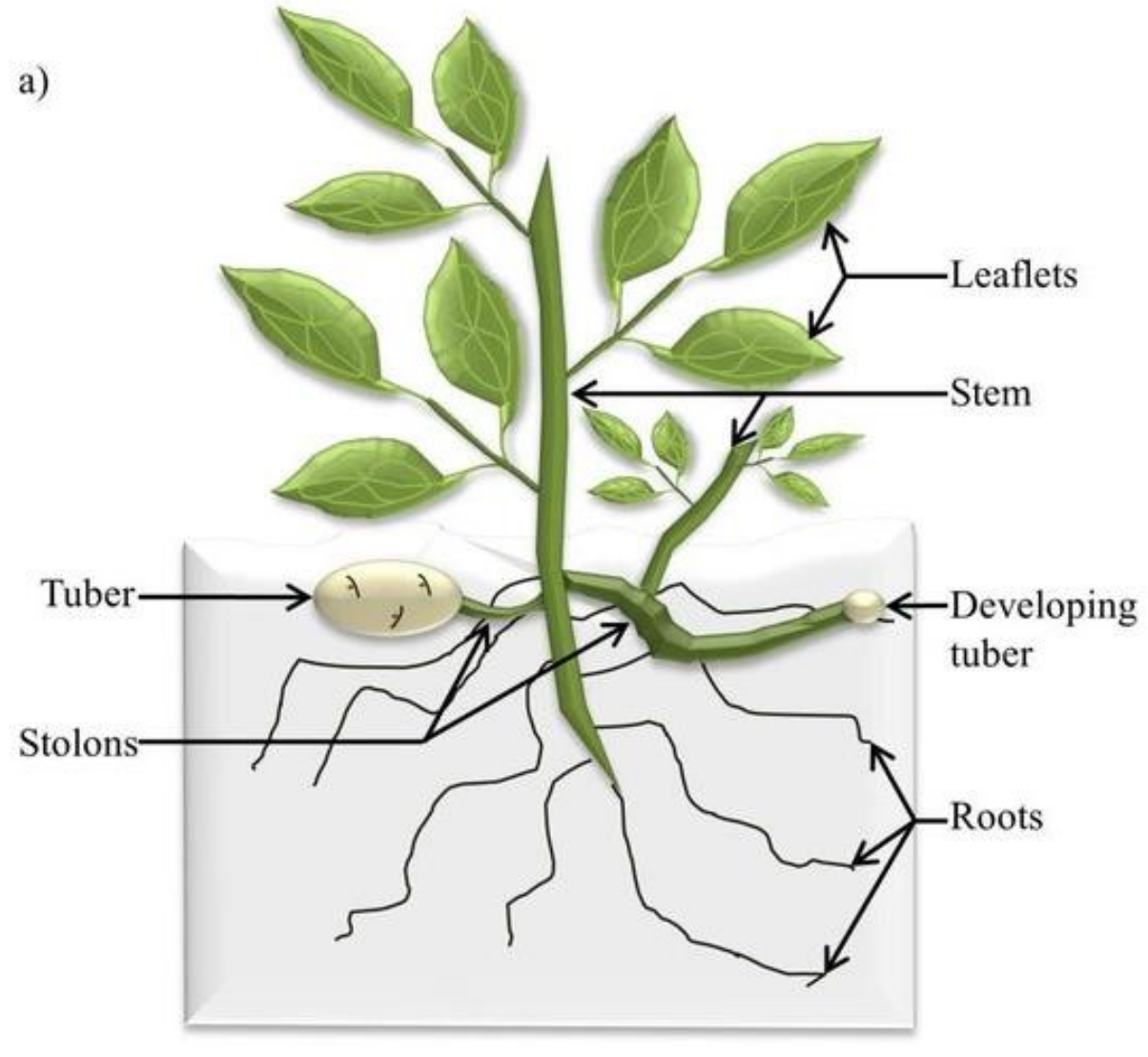
Vegetative propagation by runner in strawberry



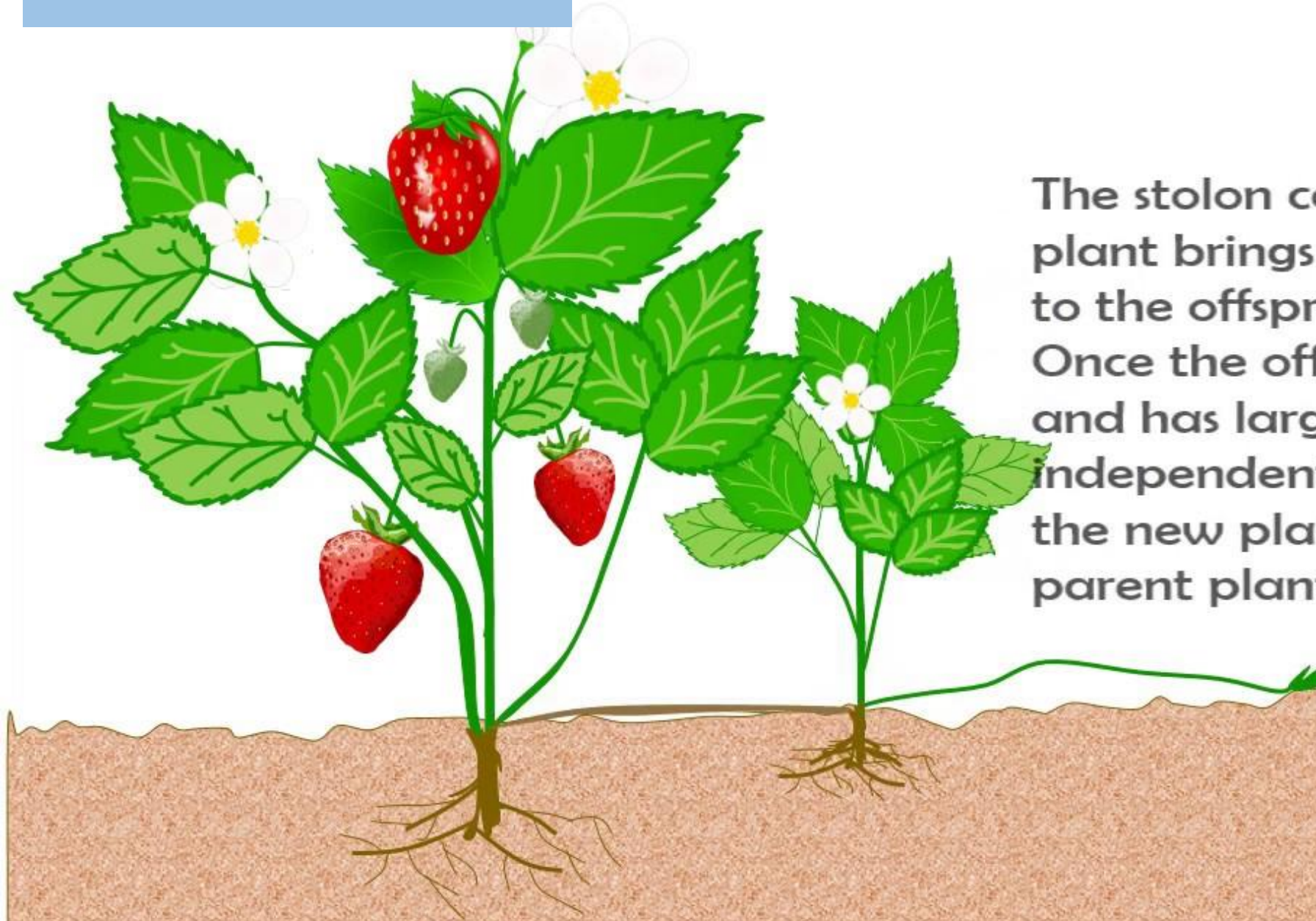
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Vegetative propagation by offset in water lettuce

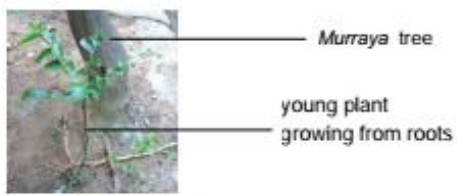
a)



Stolons= Runners



The stolon coming from the parent plant brings the necessary nutrition to the offspring enabling it to grow. Once the offspring is well rooted and has large leaves, it becomes independent. The stolon dries and the new plant separates from the parent plant.



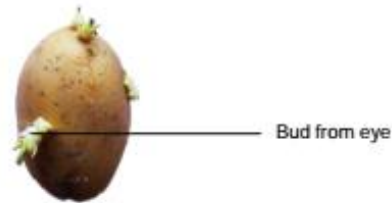
(a) Reproduction by roots – *Murraya*



(b) Rhizome – *Zingiber officinale*



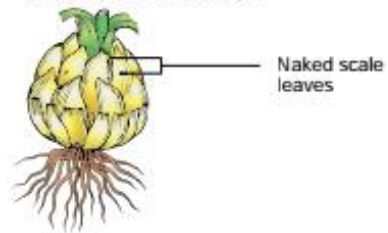
(c) Corm – *Colocasia*



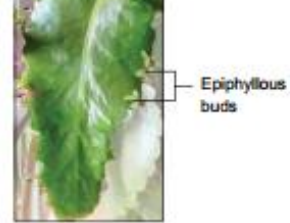
(d) Tuber – *Solanum tuberosum*



(e) Bulb
i) Tunicated – *Allium cepa*



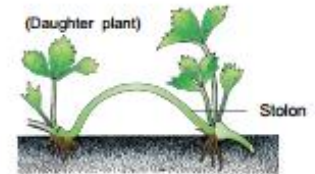
ii) Naked – *Lilium*



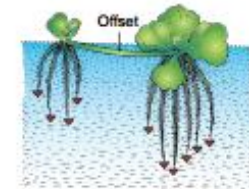
(f) Reproduction by leaf
Bryophyllum



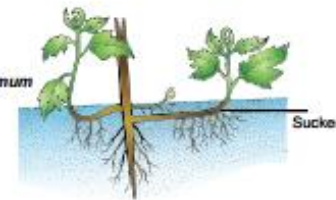
(g) Runner
Centella asiatica



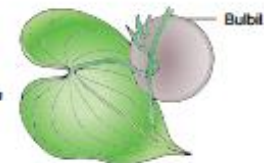
(h) Stolon
Fragaria



(i) Offset
Pistia stratiotes



(j) Sucker
Chrysanthemum



(k) Axillary bulbils
Dioscorea bulbifera

a-k: Natural methods of vegetative reproduction in plants.

- Many perennials have a plant crown, which is the part of the plant at the soil surface from which new shoots or leaves are produced.
- These plants are lifted from the soil and the crown divided into sections to produce new plants.
- A good example is the daylily, which can be divided by digging a plant and cutting it into smaller portions.
- With many herbaceous perennial plants, the central part of the crown becomes woody after several years.
- As a crown becomes woody, it produces fewer shoots and becomes less vigorous.
- When this occurs, the plants should be divided into smaller clumps and reestablished.

- Rhizomes and tubers can be dug and cut into pieces that will produce new plants.—Rhizomes are underground stems that grow horizontally just below the soil surface.
- Iris and lily-of-the-valley may be propagated by dividing their rhizomes into sections.
- Each section must have an “eye,” or node, that will produce roots for the new plant.



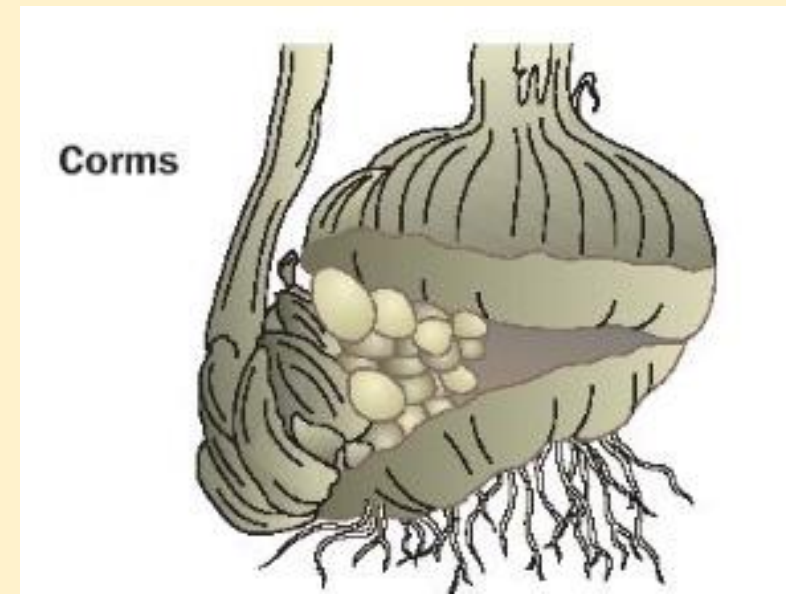
- –Tubers are underground stems similar to rhizomes except that the “eyes,” or nodes, produce new shoots instead of roots.
- Irish potato, begonia, and gloxinia are plants that produce tubers which may be used to propagate new plants.

- There are several methods used to propagate bulbs and corms.—Bulbs are shortened underground stems enclosed with fleshy leaves.
- Some species of lilies produce bulbils, or tiny aboveground bulbs, in the axils of their leaves.
- These can be removed and planted.
- Lilies also may produce tiny bulbs below the ground called bulblets.
- Some lilies and fritillaries can be propagated by removing bulb scales and placing them in moist medium.
- In time, the scales root and produce bulblets that can be separated and planted.



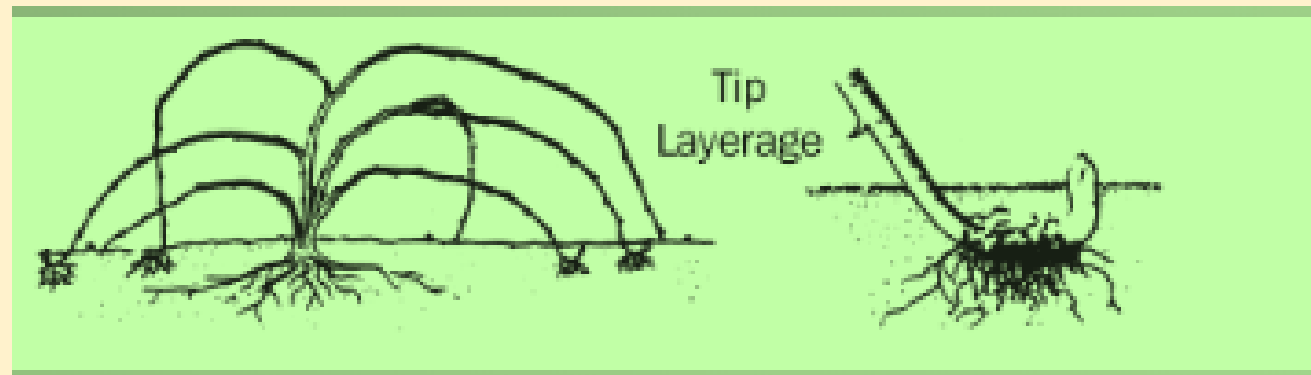
- Tulips and narcissus reproduce by natural division.
- Bulbs are produced off the main bulb.
- These are separated and planted.
- Hyacinths are very slow to reproduce by natural division.
- They can be encouraged to produce bulblets by scooping or scoring.

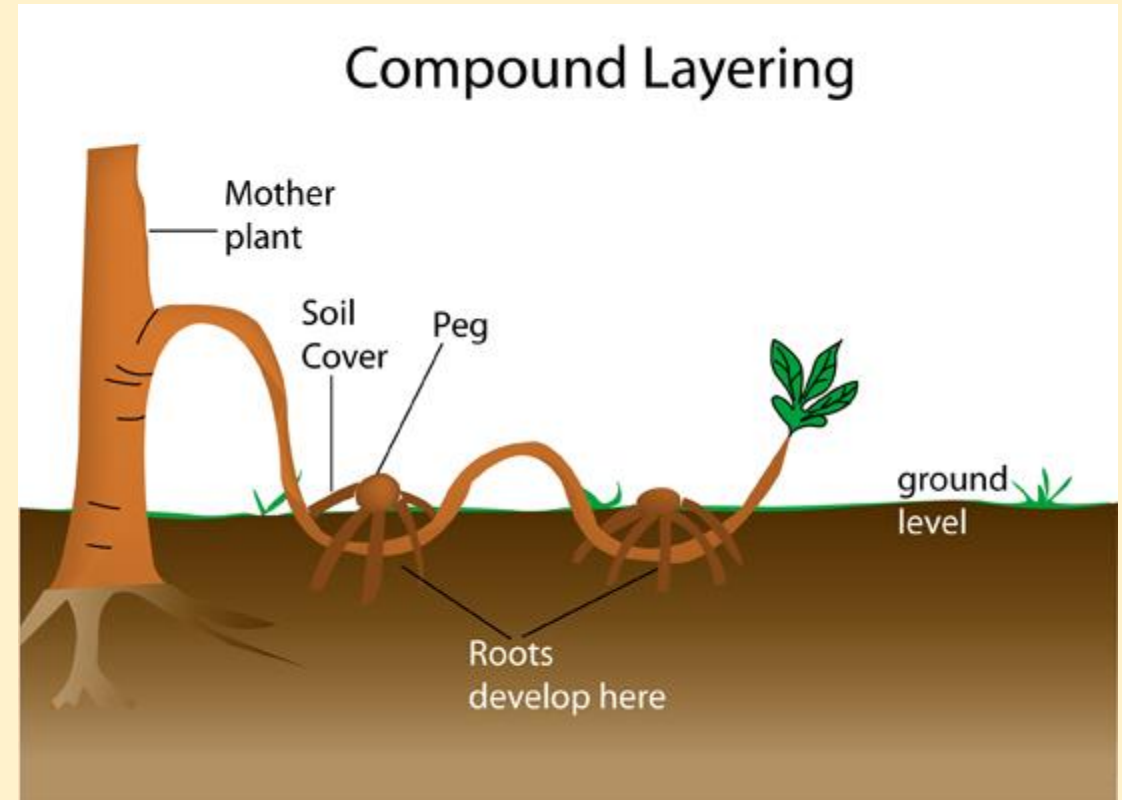
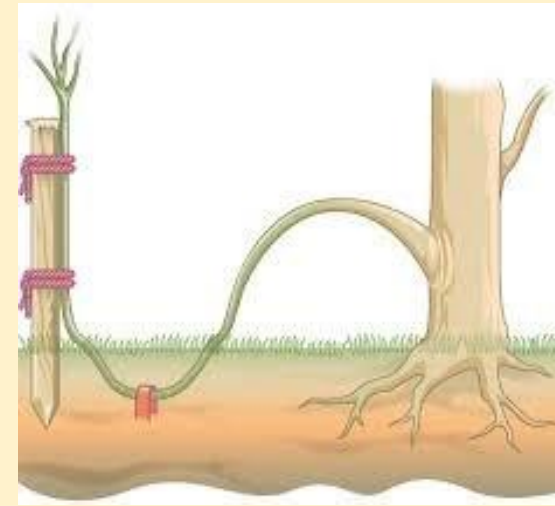
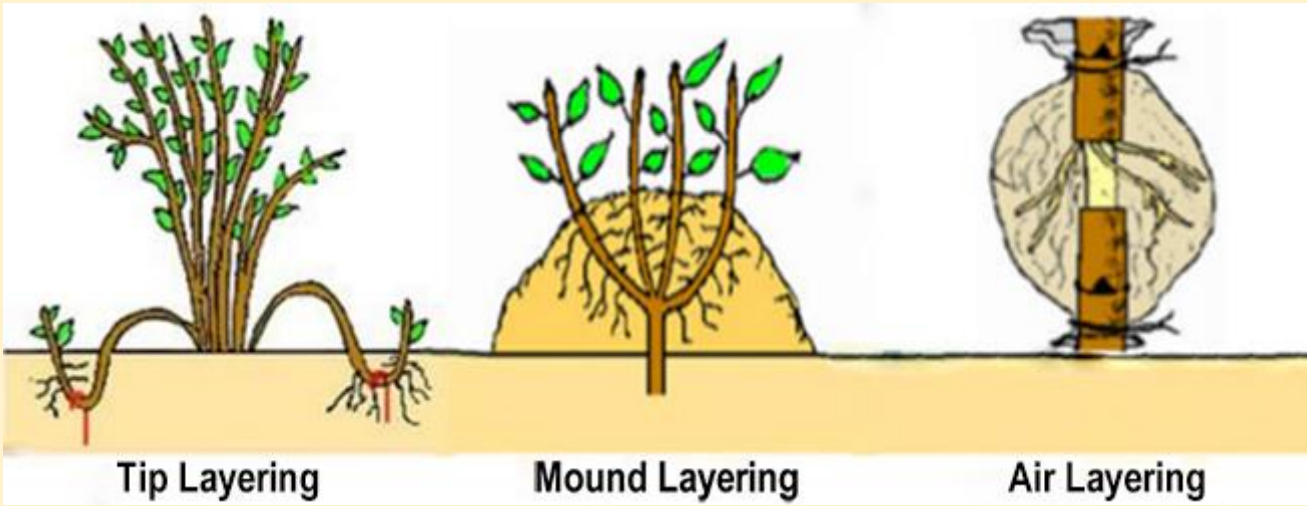
- Corms are globe-shaped, fleshy underground stems.
- Corms, including crocus and gladiola, can be cut into smaller pieces.
- Each piece of the corm must have a bud that is capable of developing into a stem.
- Corms also develop small corms called cormels.
- These miniature corms can be separated and planted.



Layering: What is the layering and how is it used to propagate plants??

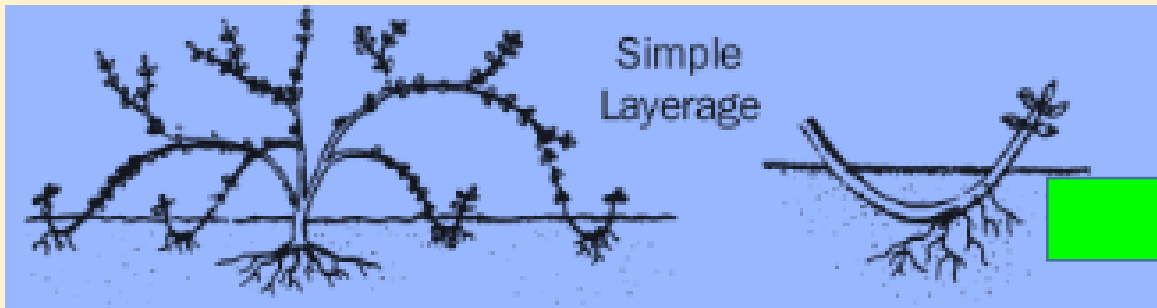
- Layering is a method of asexual propagation in which roots are formed on a stem while it is still attached to the parent plant.
- The parent (mother) plant supports the new plant during root development.
- Once the new plant can function on its own, it is removed from the parent.





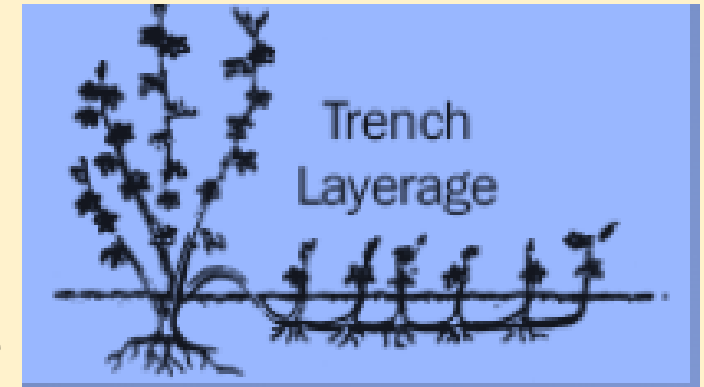
Simple layering

- Simple layering is accomplished by bending a branch to the ground, slightly cutting or wounding the stem, and covering the wounded portion with 2 to 3 inches of soil.
- The wounded area forms a callus and then produces new roots.
- After new roots are fairly well developed the plant is removed from the parent plant.
- Many types of woody shrubs can be propagated using this method.



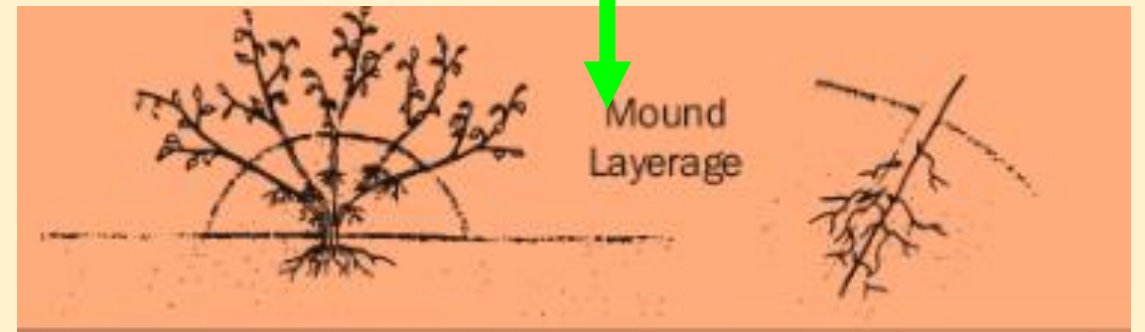
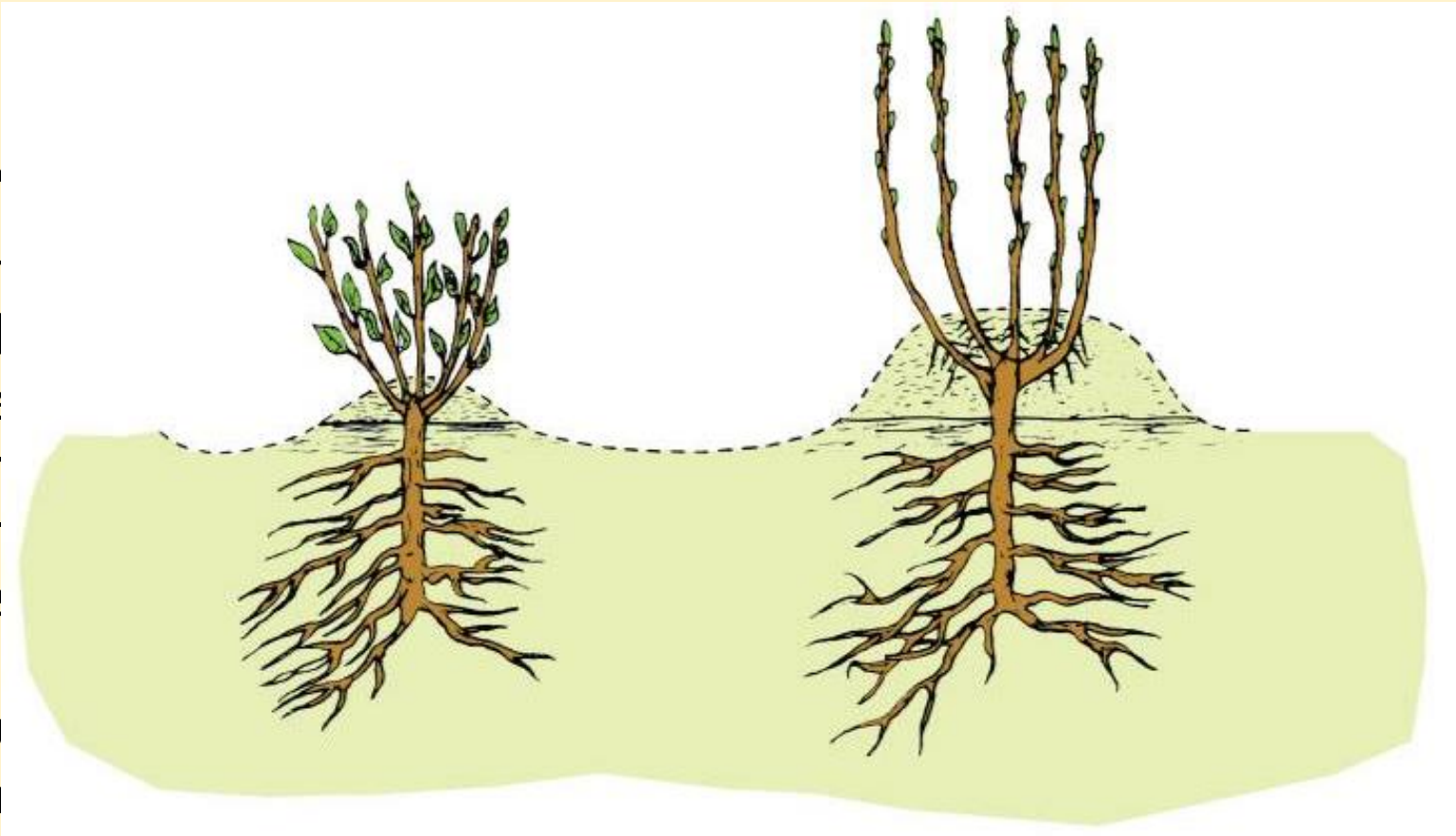
Trench Layering

- Trench layering involves a shallow trench that is dug near the parent plant.
- An entire branch is bent over, placed in the trench, and then covered with 2 to 5 inches of soil.
- After a few weeks, roots develop along the stem, and new shoots form at each node.
- When the new plants reach the desirable size, they are separated from the parent plant.
- This method often produces many new plants and is used for fruit and nut trees that do not easily propagate from cuttings.



Mou

- Ornamental plants are frequently layered.
- To perform layering, a 4-inch stem is bent to the ground.
- The stem is buried under a mound of soil.
- The mound is watered until the following spring.
- During that time roots develop at the base of each stem.
- The newly rooted plants can then be separated from the parent plant.

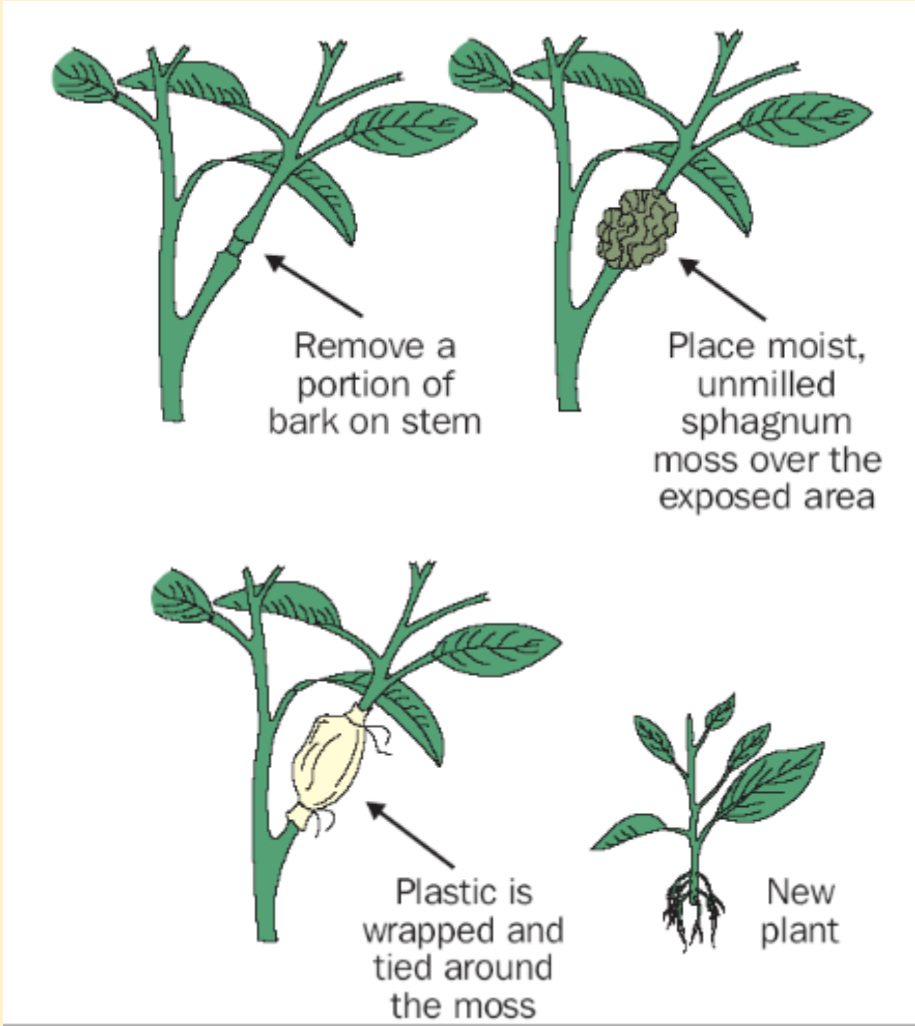


Air layering

- Air layering involves girdling the stem about 6 to 9 inches from the growing tip.
- Root-inducing hormone is applied to the cut area and moist sphagnum moss placed over the exposed area.
- Plastic is wrapped around the moss and tied to maintain moisture.
- After roots develop, the top part of the plant is cut just below the rooted area.
- The new plant is then potted to grow on its own.
- Foliage plants are occasionally propagated by air layering.



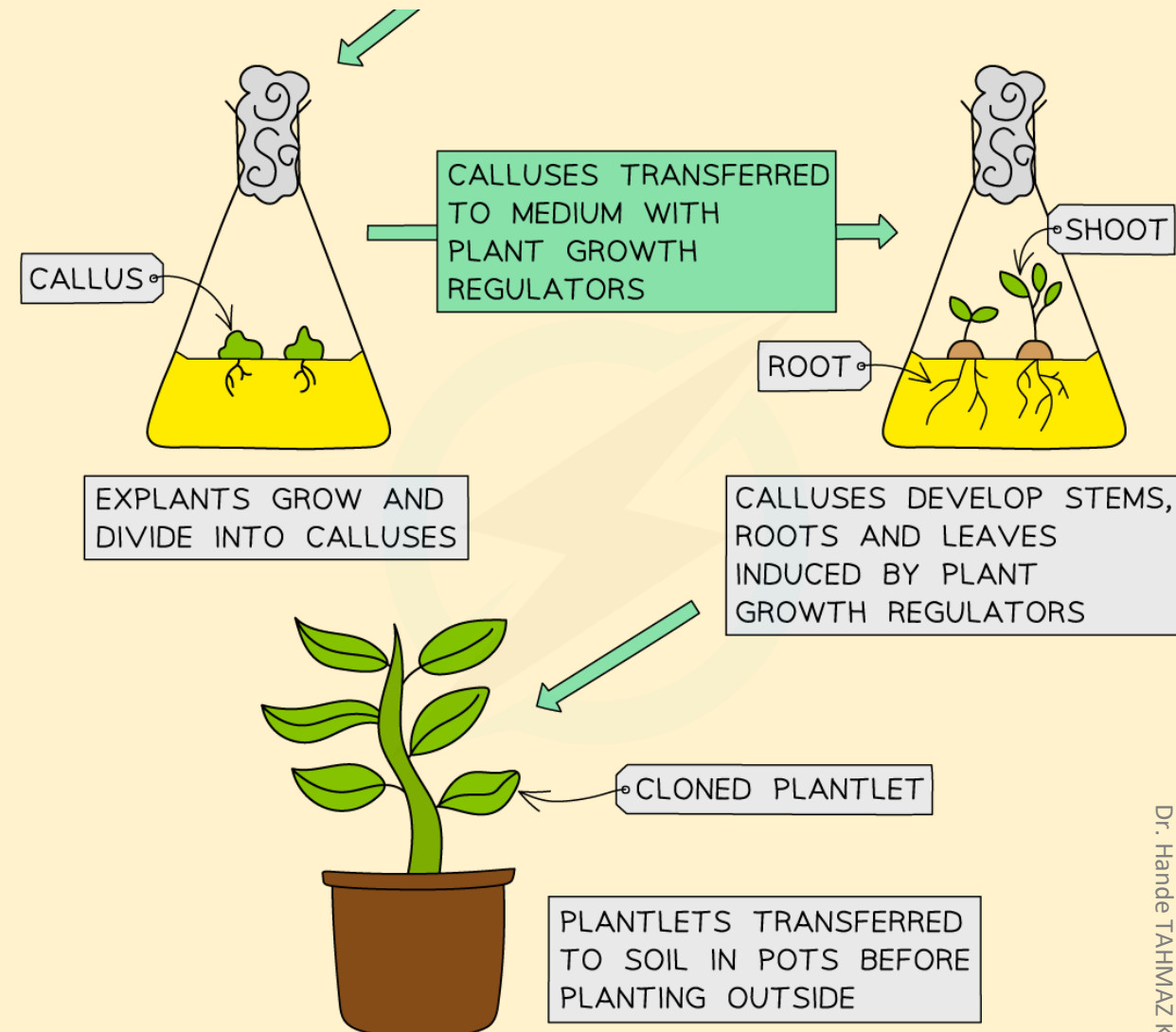
Air layering

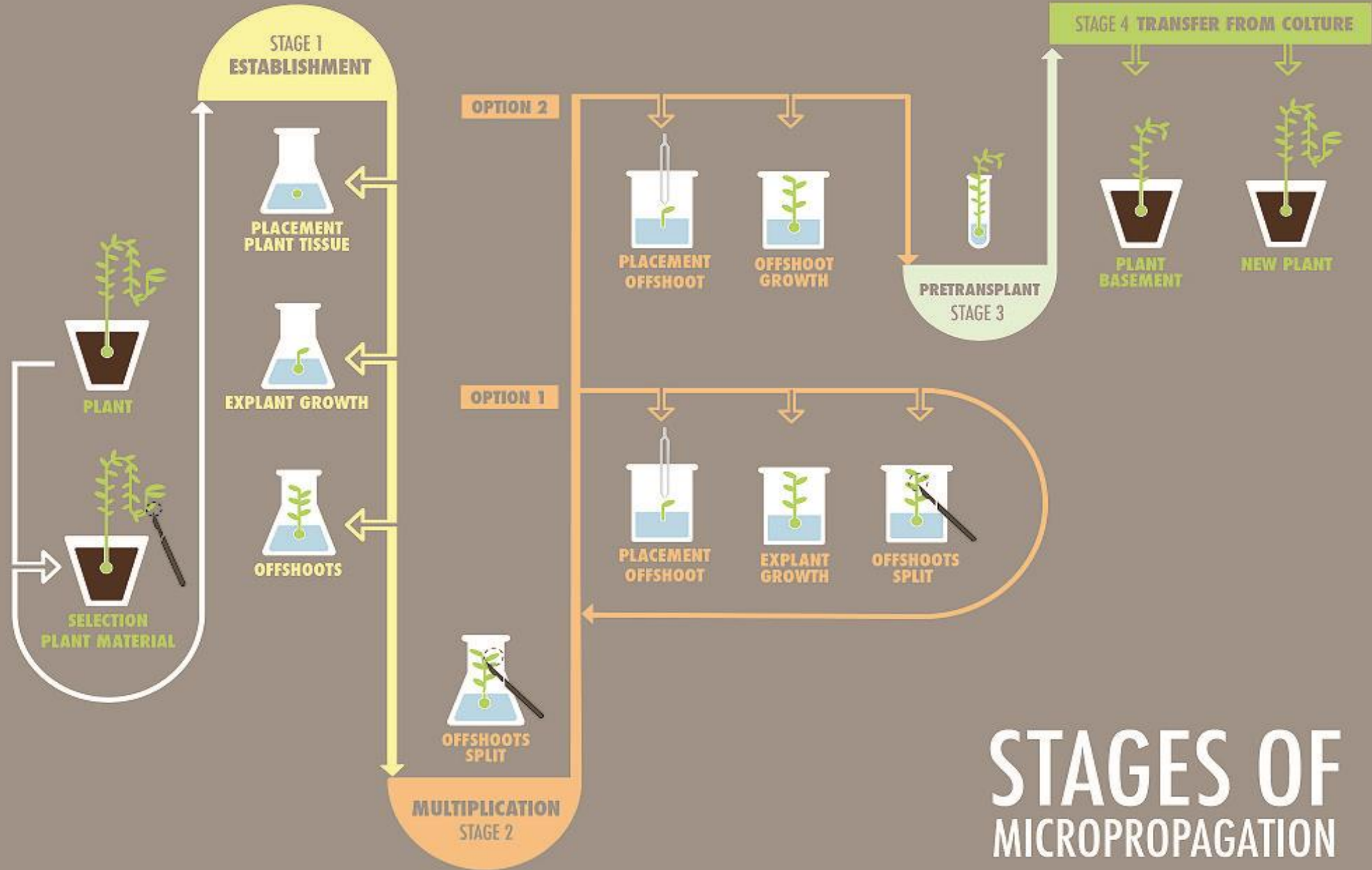


Micropropagation

Micropropagation involves the application of tissue culture techniques to propagate plants from very small plant parts (parts of leaves, stems, shoot tips, root tips, single cells, and pollen grains). The small plant part is grown (cultured) in a test tube, petri dish, or other sterilized container with a culture medium and precise environmental conditions. The container and growing medium must be sterilized. Because plants often harbor bacterial and fungal spores, the plant tissue must also be disinfected.

Micropropagation is a rapidly growing part of the plant propagation industry. It is not practical for most home gardeners because of the very specific requirements of the culture media and the constant efforts that must be made to avoid possible contamination from disease organisms. For nurseries, special care must be taken in transporting micropropagated plants from the lab to the store because they are not acclimated to outdoor growing conditions.





STAGES OF MICROPROPAGATION



4 weeks 4 weeks 4 weeks

Introduction Initial culture on solid medium



6 weeks 2-4 weeks

Multiplication in bioreactor **Rooting in bioreactor**



4 weeks

Hardening

