Unit 11 · Asexual Reproduction

STUDY NOTES

WHAT NEB'S GRADE 12 EXAM ASKS

- **CDC's grid (2078):** Embryology (Units 11–12 together): 5 of 75 marks; 1 MCQ (knowledge) and 1 short question (4 marks: knowledge 2, higher ability 2)
- **The paper:** Botany 37 + Zoology 38; each part: MCQs × 1 (5 Botany, 6 Zoology) · 4 short × 4 · 2 long × 8; one OR in each short and long group; 3 hours; 1 mark per expected point
- **CDC's model paper:** short: micropropagation and its stages (4)
- **MCQ (1 mark)**
  - agamospermy; adventive embryony from nucellus or integument
  - ginger: rhizome; runner (dubo, strawberry)
  - disadvantage: disease spreads to all
  - explant; orchid saved by tissue culture
  - *Eichhornia* offsets choke water bodies
- **Short (in parts)**
  - vegetative propagation; micropropagation
  - layering with a diagram; cutting vs grafting
  - how it keeps a plant's traits
  - propagating a rose; grafted vs seedling mangoes
  - a wedge graft from a figure: label, plant, advantages
  - benefit and risk in modern farming

Key terms

Asexual reproduction: no fusion of gametes; one parent; offspring genetically identical (mitosis).

Apomixis ("without mixing"): agamospermy, and in the older sense vegetative propagation.

Agamospermy: seeds formed **without fertilization**.

Adventive (nucellar) embryony: embryo from a diploid **nucellus or integument** cell.

Polyembryony: several embryos in one seed.

Parthenogenesis: embryo from an unfertilized egg.

Diplospory: megaspore mother cell skips meiosis → diploid embryo sac.

Apospory: another nucellus cell → diploid embryo sac.

Parthenocarpy: fruit without fertilization, no embryo, no seed.

Vegetative propagation: new plant from a root, stem, leaf or bud.

Clone: offspring of one parent, all with the same genes (Greek *klon*, twig).

Adventitious roots: from a stem or leaf, not the radicle.

Scion: upper part of a graft; **stock**: rooted lower part.

Explant: small plant piece used in tissue culture.

Totipotency: a plant cell's ability to grow into a whole plant.

Asexual reproduction

- saffron (triploid), garlic: one clone, grown from corms, cloves
- **strengths**: colonize fast (dubo, water hyacinth); no pollinator or partner; keeps a good combination in a stable place
- **weakness**: no variation → less able to adapt

Agamospermy

- ovule: **nucellus** in **integuments**; megaspore mother cell (2n) → meiosis → **embryo sac** with **egg (n)** → fertilized → zygote (2n)

a. Adventive (nucellar) embryony

- embryo from a **diploid nucellus or integument cell**, outside the embryo sac; not from an egg
- **polyembryony**: citrus seed gives 2–3 seedlings
- *Citrus* (orange, lemon, junar), *Opuntia*, some mangoes

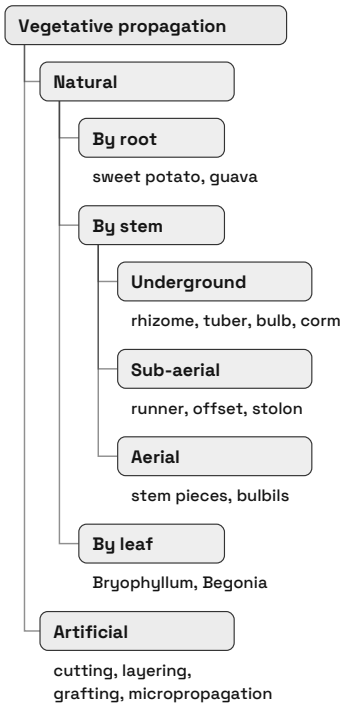
b. Recurrent agamospermy

- **diploid egg**, no meiosis, **no fertilization** (parthenogenesis)
- **diplospory**: megaspore mother cell skips meiosis (dandelion, *Taraxacum*)
- **apospory**: other nucellus cell → embryo sac (Kentucky bluegrass, *Poa*)
- repeats generation after generation; mother's genes exactly; *Rubus*

c. Non-recurrent agamospermy

- **haploid egg** (normal meiosis), no fertilization → **haploid**, not identical, **sterile**
- can't repeat; rare: *Solanum*, *Lilium*, *Nicotiana*
- breeders double haploids → pure lines
- **seedless ≠ apomictic**: banana is **parthenocarpic** (no embryo); seedless grapes: seeds abort; both propagated vegetatively

Natural vegetative propagation



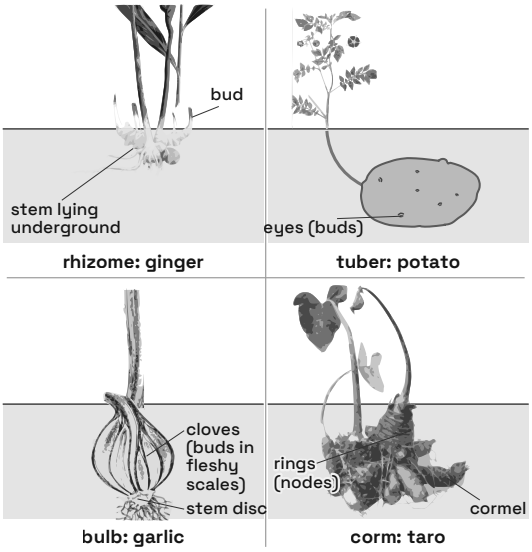
Kinds of vegetative propagation.

Roots (adventitious buds)

- **sweet potato** slips; **guava**, shisham root suckers; **asparagus** clumps divided
- a swollen root has no nodes, no scale leaves; buds anywhere

Underground stems (nodes, internodes, scale leaves, buds)

- **rhizome**: horizontal; ginger, turmeric, bamboo, lotus
- **tuber**: swollen stolon tip; **eyes** = nodes with buds; potato, yam; only pieces with an eye grow
- **bulb**: disc stem, **fleshy scale leaves** store food; onion, garlic, tulip, lily
- **corm**: **solid swollen stem**, dry papery scales; *Gladiolus*, saffron, taro (pindalu); cormels



Underground stems.

Sub-aerial stems

- **runner**: slender, creeps, roots at nodes; dubo grass, *Oxalis*, strawberry
- **offset**: short, thick, **one internode**, rosette; water plants: water hyacinth (jalkumbhi), *Pistia*
- **stolon**: arches down, roots where it touches; mint, jasmine

Aerial stems: *Opuntia* pieces; **bulbils** (*Dioscorea bulbifera*, *Agave*); sugarcane, bamboo nodes

Leaves (adventitious buds)

- *Bryophyllum* (pattharchatta): buds in **leaf-margin notches**
- *Begonia*: plantlets where veins are cut
- **walking fern** (*Adiantum caudatum*): frond tip roots

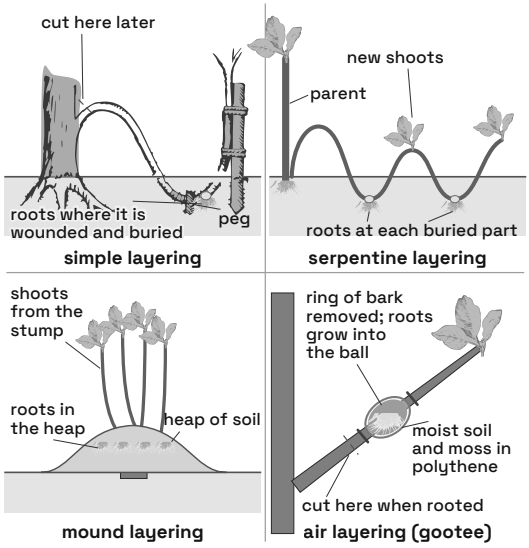
Artificial vegetative propagation

Cutting

- stem piece 15–25 cm, several nodes; lower leaves off; nodes buried → **adventitious roots**
- rooting powder (**IBA**, an auxin) speeds rooting
- rose, sugarcane (setts), cassava, grapevine, *Hibiscus*, bougainvillea, chrysanthemum; root cuttings (horseradish); leaf (*Begonia*, snake plant)

Layering: roots form while still on the parent; wound cuts phloem → sugar, auxin collect

- **simple**: branch bent, cut, buried; jasmine, grapevine, lemon
- **serpentine**: in and out of soil; many plants on one branch; *Clematis*
- **mound (stool)**: parent cut back; soil heaped round new shoots; apple rootstocks, currants
- **air (gootee)**: ring of bark removed; rooting hormone; moist soil and moss in polythene; cut below the ball; litchi, guava, lemon, pomegranate

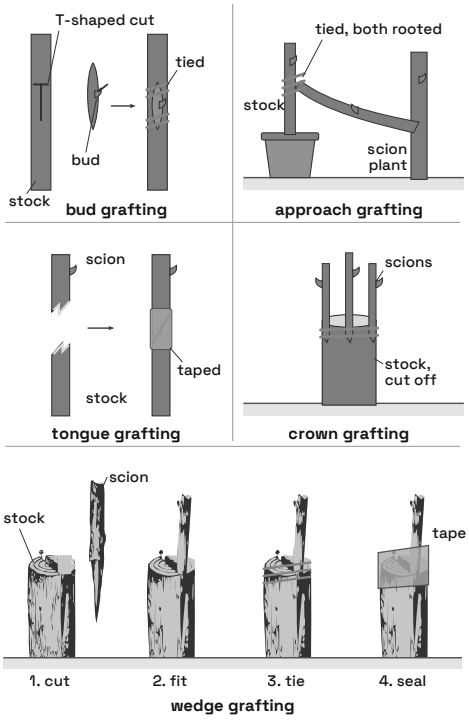


Kinds of layering.

Grafting: two plants joined as one

- **scion**: wanted fruit, flowers (decides fruit taste); **stock**: strong roots, hardiness, soil-disease resistance

- **cambium to cambium** → new xylem, phloem across the joint; tied, sealed
- closely related (same species or genus)
- **bud (T-budding)**: a bud under T-cut bark; rose, citrus, peach
- **approach (inarching)**: scion still on its parent until joined; mango, litchi
- **tongue (whip-and-tongue)**: same thickness, cuts lock; apple, pear
- **crown (rind)**: several scions between bark and wood of a cut old tree
- **wedge (cleft)**: stock split, wedge scion pushed in; mango, apple, walnut



Kinds of grafting.

	Cutting	Grafting
plants	one	two joined
roots	its own adventitious	the stock's
parts	stem, root or leaf piece	scion + stock
skill	simple	needs matching cambium
examples	rose, sugarcane	mango, apple, citrus

Micropropagation

- many identical plants from an **explant** on a **nutrient medium** with **hormones**, **sterile**; works by **totipotency**

1. **choose, sterilize explant**: shoot tip; bleach or alcohol (germs outgrow the plant)
2. **start culture**: **agar** + sugar, salts, vitamins, hormones; closed jar, warm, lit
3. **multiply**: shoots directly or via **callus**; **high cytokinin : auxin** → **shoots**; cut apart and **subcultured**
4. **root**: medium rich in **auxin** → **plantlets**
5. **harden**: pots, greenhouse, then field

- **shoot-tip** (meristem) culture → **virus-free**: seed potatoes, banana
- uses: potato, banana, sugarcane, strawberry; **orchids**, *Gerbera*; forestry; **conservation** of rare plants
- Nepal: potato, banana, orchids in labs; details in Unit 13

Advantages and disadvantages

Advantages

- **faster**: grafted mango fruits in 3–4 years, seedling 6–8+
- **genetically identical** → desired traits kept
- seedless plants: banana, sugarcane, garlic, saffron, seedless grapes
- **uniform** growth and yield
- **disease-free** plants (micropropagation)
- large-scale commercial growing

Disadvantages

- fewer, bulky pieces; spoil, can't be stored long
- **no variation** → all equally open to disease, pests
- **diseases spread** with pieces; viruses build up
- no taproot; some shorter-lived
- not for every species (most cereals)
- same clone over large areas → low diversity
- Cavendish banana (one clone) threatened by Panama disease TR4; Gros Michel wiped out by 1960s
- rose: stem cuttings 15–25 cm in rooting powder, or layering, T-budding

COMMON MISTAKES

✗ Agamospermy has no seed
✓ there **is** a seed; its embryo isn't fertilized.

✗ Seedless banana shows agamospermy
✓ **parthenocarpy** (no embryo).

✗ Adventive embryos come from the egg
✓ from **nucellus or integument** cells.

✗ Non-recurrent agamospermy gives diploid plants
✓ **haploid**, sterile.

✗ Potato is a root
✓ a **stem** tuber (eyes = nodes); sweet potato is a root.

✗ Onion stores food in its stem
✓ in **fleshy scale leaves**; a corm stores it in the stem.

✗ The stock decides the fruit's taste
✓ the **scion**.

✗ Shoots form with high auxin
✓ **high cytokinin**; auxin gives roots.