Propagation

"to cause an organism to multiply by any process of natural reproduction from the parent stock"

Gretel Anspach
Lifetime Master Gardener
Massachusetts Master Gardener Association

Types of Propagation

- Seeds (sexual)
- Vegetative (asexual)
  - Division and Separation
  - Runners and Suckers
  - Layering
  - Cuttings
  - Grafting & Budding

This lecture

- Micropropagation (tissue culture, etc.)

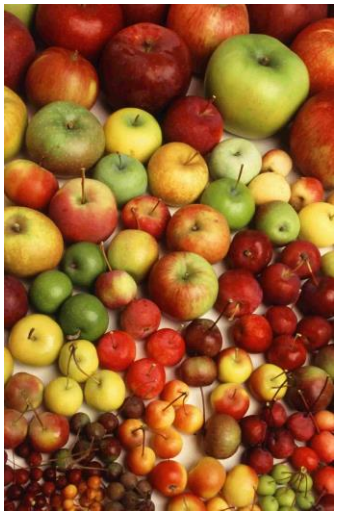
Propagation

Sexual – Genetic mix of 2 individuals

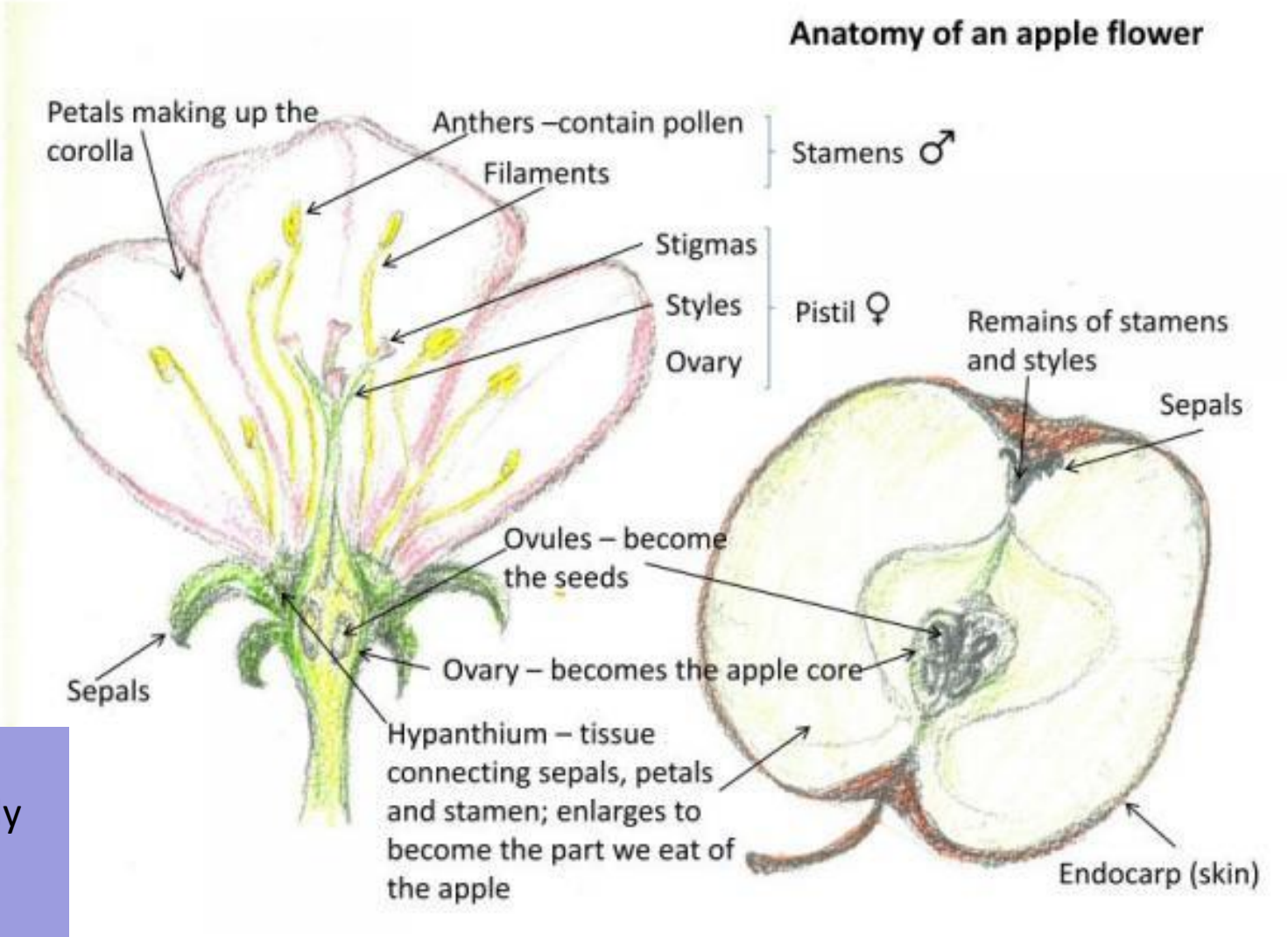
- Even in-bred lines show variety
- Evolution to different forms, hardiness, etc.
- Slow, random

Asexual – Clone of 1 individual

- Exact duplicate
- Strengths & weaknesses retained
- Faster (generally)



Flowers into Fruit



Seeds are the only part that genetically combines both parents.

https://www.theorchardproject.org.uk/blog/blossoming-cities/

Cucurbita pepo













- Acorn squash
- Delicata squash
- Dodi marrow
- Gem squash
- Heart of gold squash
- Kamo Kamo
- Pattypan squash
- Some gourds
- Some pumpkins
- Spaghetti squash
- Sweet dumpling squash
- Yellow crookneck squash
- Yellow summer squash
- Zucchini

Terms – Open Pollinated vs Hybrid

Open pollinated

AA

x

aa

First generation hybrid (F1)

Aa

2nd generation hybrid (F2)

AA

Aa

Aa

aa

Four O'Clock (Mirabilis jalapa)

“Sports”

Division and Separation

- Creates more plants
- Rejuvenates older plants
- Controls spread of plants

Division / Separation – Timing

- Ideally
  - Divide spring and summer bloomers in fall
  - Divide fall bloomers in summer
- In reality
  - Avoid mid-summer (unless you water)
  - Give time for roots to establish themselves before ground freezes
  - Divide when you see there's a problem – generally lack of flowers

Root systems

- Spreading root systems (e.g. bee balm)
- Clumping root systems (e.g. daylilies)
- Rhizomes (e.g. irises)
- Stolons (e.g. strawberries)
- Tubers (e.g. dahlias)
- Bulbs / Corms (e.g. daffodils, lilies)

Spreading / Clumping Root Systems

- Ideally
  - Water the plant a day or two before dividing
  - Pick a cloudy day to divide the plant
  - Dig the plant up
  - Shake or wash the soil off the roots
  - Separate the plant by hand, knife, shovel, or fork
    - At least one growing point per division
  - Replant immediately
- In reality
  - Can just cut out a portion of a plant in the ground

Spreading / Clumping Root Systems

Rhizomes

- Water the plant a day or two before dividing
- Pick a cloudy day to divide the plant
- Dig the plant up
- Shake or wash the soil off the roots
- Cut off and discard any shriveled rhizomes
- Cut off and discard any rhizomes that do not have leaves
- Separate the remaining rhizomes into sections with one fan of leaves each
- Replant immediately; take care to plant at the same depth as before you dug it up

Rhizomes

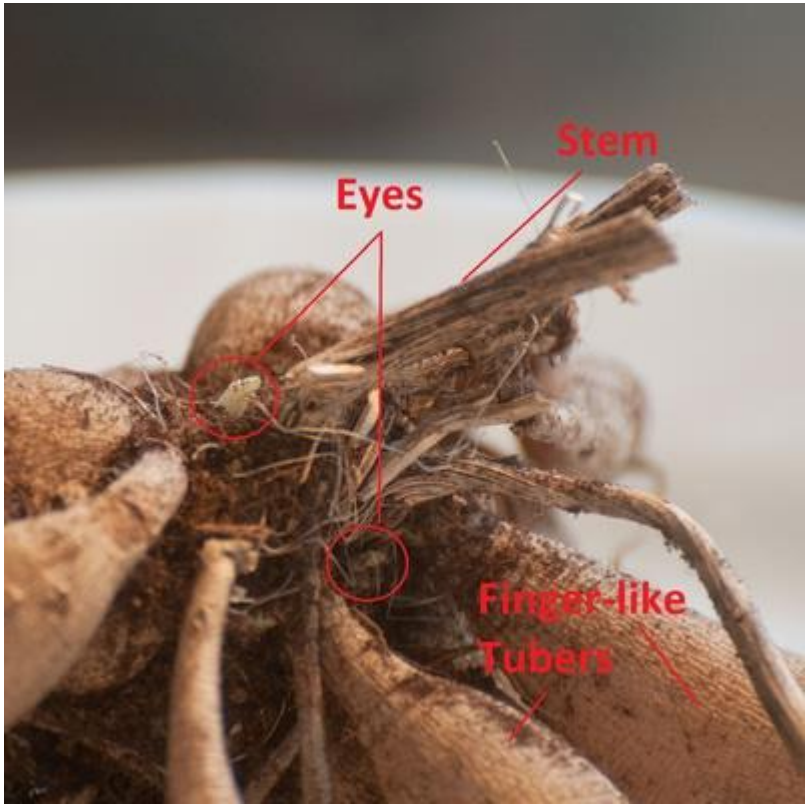
Stolons

- Check that the daughter plant is well rooted by tugging on it gently
- Cut off the stolon at both ends

Tubers

- Lift the clump of tubers out of the ground and brush off the soil
- Cut away the thin roots so it's easier to see what you're doing
- Divide the clump with pruning shears or a sharp knife
  - Make sure each division has a tuber with an eye
  - It's ok (and easier) to include part of the old stem
- Discard any tubers that don't have eyes or are soft
- Advice varies on whether to divide in spring or fall
  - Professionals divide tubers in the fall (easier to store)

Tubers



Bulbs and Corms

Overgrown patch of daffodils – lots of leaves, no flowers

Dig the patch up with spade or fork

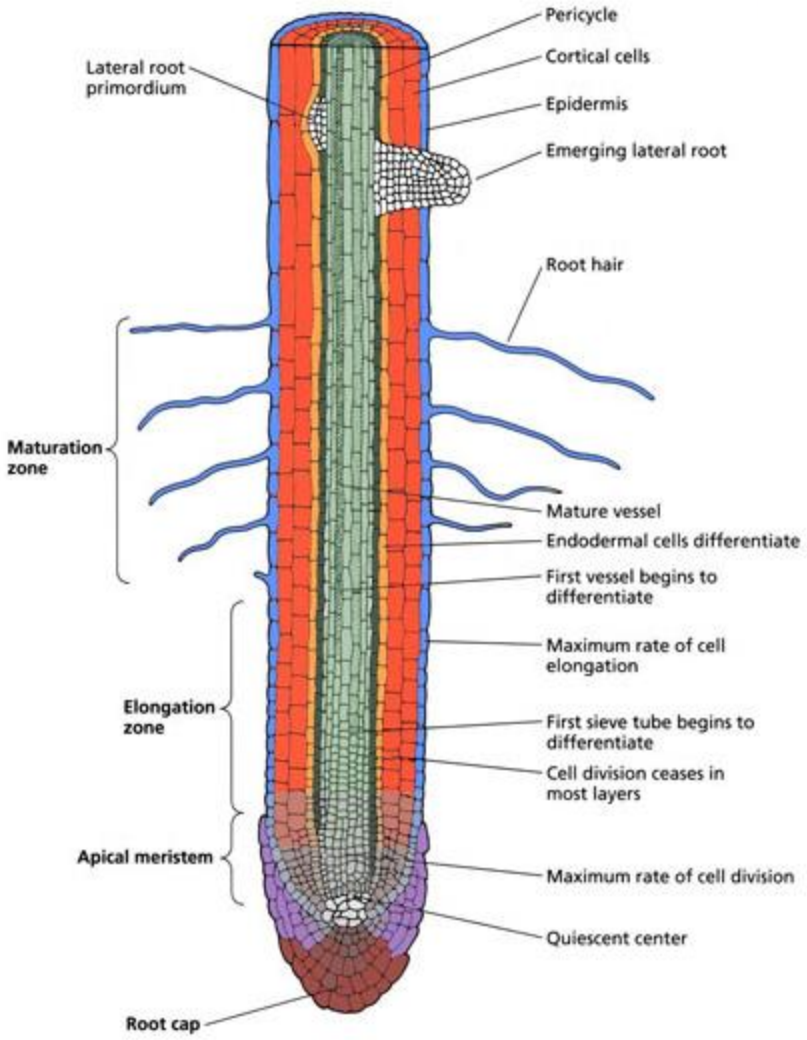
Replant individual bulbs

Should all bloom next year

Cuttings

- Kinds of cuttings
  - Stem
  - Root
  - Leaf
- Vocabulary
  - Totipotency – the ability of any individual cell to produce all the other cells in an organism
  - Differentiation – the process where a meristem cell generates specialized cells, such as xylem, phloem, bark, epidermis, etc.
  - Dedifferentiation – the process where a specialized cell turns back into a meristem cell

Roots



Mature zone
- Most cells are mature
- Root hairs have sheared off
- Lateral roots may form

Maturing zone
- Root epidermis form root hairs to maximize surface area for absorbing nutrients
- Some cell lengthening

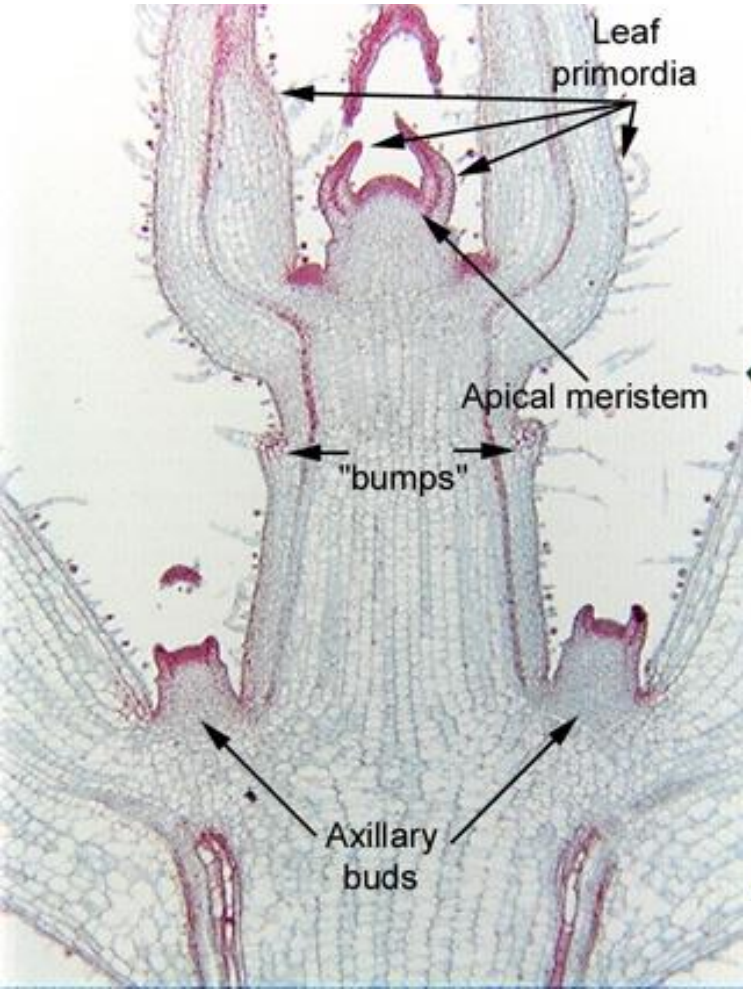
Elongation zone
- Cells differentiate (take on different functions)
- Cells grow longer – this is primary mechanism for root growth

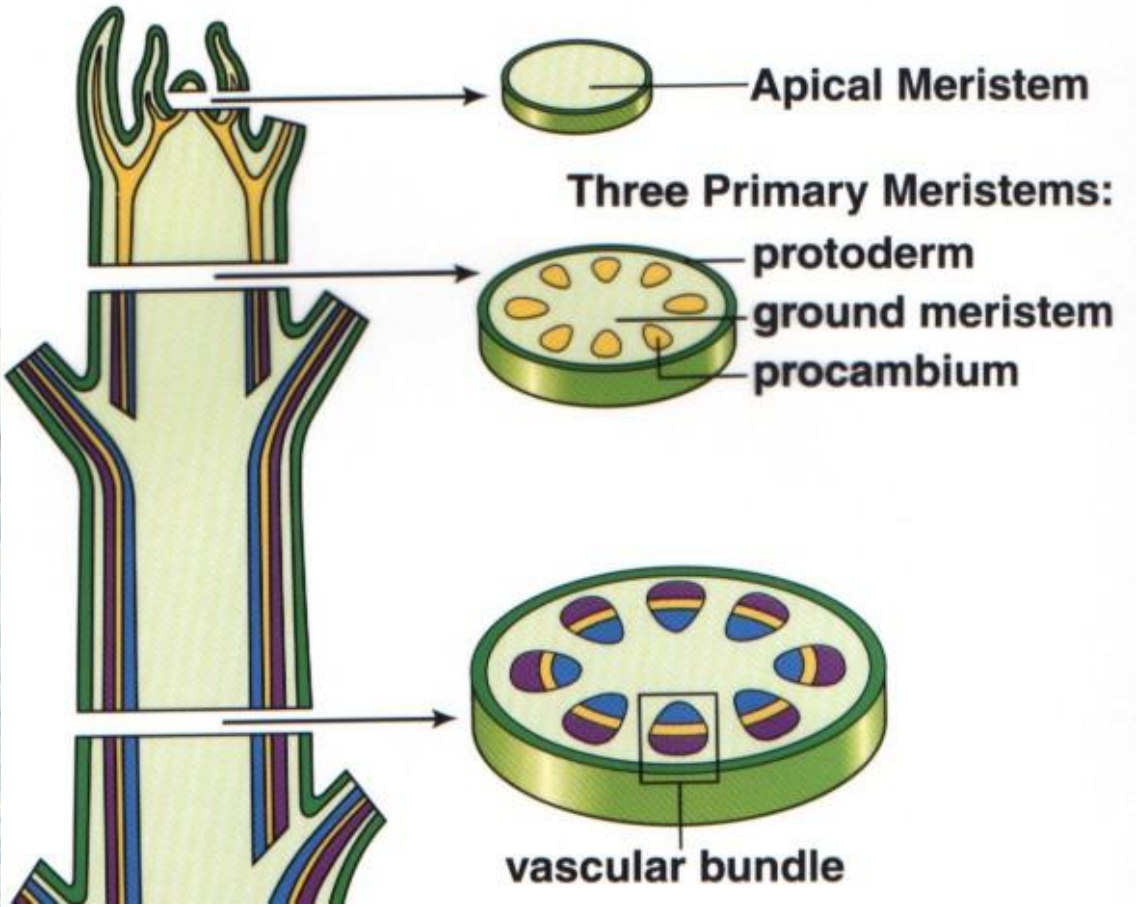
Cell Division zone
- Makes more cells

Root Cap
- Perceives gravity
- Protects growing tip of root
- Excretes lubricant (mucilage)

http://vannocke.hrt.msu.edu/plb865/29oct/structuredevel.html

Stems





http://www.sbs.utexas.edu/mauseth/weblab/webchap6apmer/6.1-1.htm

http://www.bio.miami.edu/dana/226/226F09_5.html

Stem Cuttings – in general

After a plant is cut or wounded:

- The cut scabs over to protect against drying out and disease
- Buds in the cut piece generate phytohormones
  - Auxins: promotes root development
  - Cytokinins: promotes shoot development
- The phytohormones cause cells behind the scab to dedifferentiate and become meristems
  - Which cells dedifferentiate is different for different species
- The meristems generate roots

The trick in rooting cuttings is to take the cutting when the plant generates the best combination of phytohormones.

Stem Cuttings

- Softwood cuttings
  - Taken from woody plants during spring and early summer
  - Stem is still green but not too succulent
- Semi-hardwood cuttings
  - Taken from woody plants during late summer and early fall
  - Stem is brownish
- Hardwood cuttings
  - Taken from woody plants in winter when the plant is dormant
- Herbaceous cuttings
  - Taken from herbaceous plants (not trees and shrubs)

Softwood Cuttings - Hydrangea

Butterfly cutting (top)

Double-eye single node cutting (middle)

Single-eye single node cuttings (bottom)

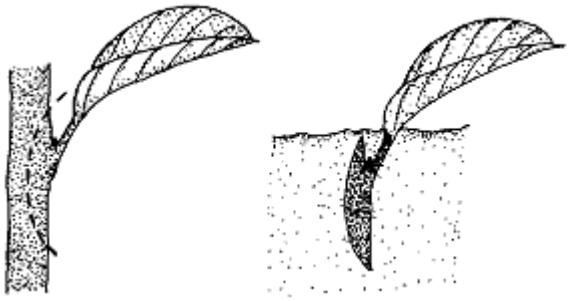
From NDSU PLSC 368 Plant Propagation lecture

Stem cuttings – Process

- Research the right time of year to do the cutting
- Cut off the stem with a sharp knife or by-pass pruners. Select a very healthy looking stem.
- Keep the end moist (wrap in damp paper towel till ready to proceed)
- Cut the stem into sections – at least one bud per section, ideally 2”-8” long
- Consider moistening the root end of the cutting and dipping it in rooting hormone (IBA – synthetic auxin). Knock off the excess.
- Poke a hole larger than the stem end in dampened growing medium (sand, vermiculite, perlite, coir, etc.). Put the stem in the hole and firm the medium around it.
- If the cutting has large leaves, consider cutting them in half.
- Consider placing the pot in a baggy to increase humidity.
- Place the pot in shade and keep it moist.
- After 2-4 weeks, tug gently on a cutting. If it resists, it has rooted and can be transplanted into soil.

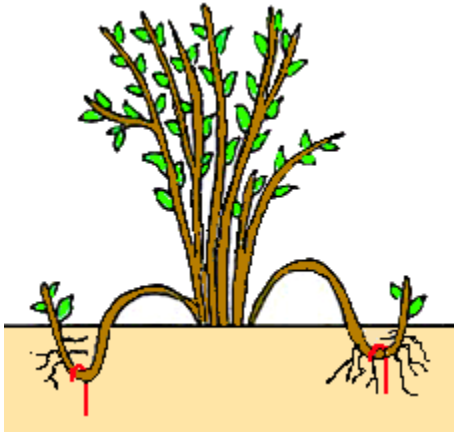
Stem cuttings – helpful hints

- Stem cuttings have polarity – they know which end should develop roots
  - If you put the cutting in upside down, roots will form on the top
  - Some people cut the root end at an angle and the top end flat to tell the difference.
- If the root zone is 10 degrees warmer than the air, the cutting will root faster
- Double-eye cuttings seem to have higher success rate than single-eye cuttings
- Can also try leaf-bud cuttings

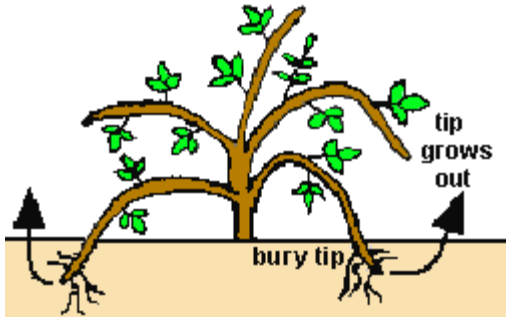


Layering – Easy Stem Cuttings

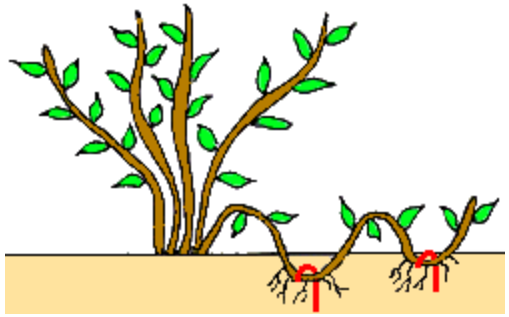
Notch stem and place in contact with moist growing medium



Simple layer

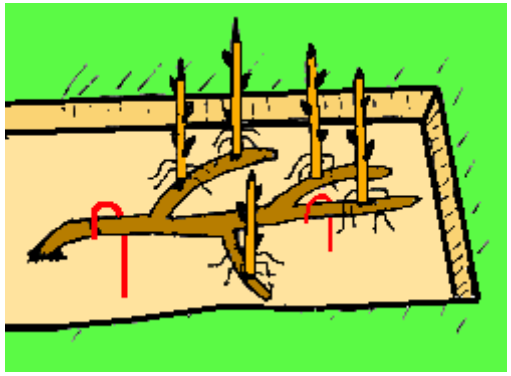


Tip layer

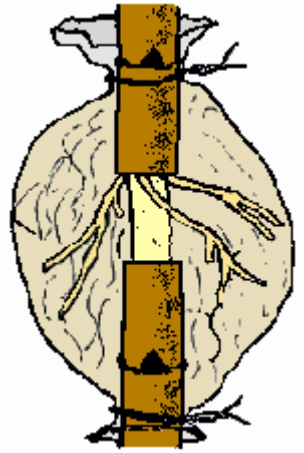


Serpentine layer

Mound layer



Trench layer



Air layer

From http://hort201.tamu.edu/YouthAdventureProgram/AsexualPropagation/AsexaulPropagation.html

Root cuttings

- Timing
  - Generally done in very early spring just before plant breaks dormancy – when the plant has the most energy stored in the roots
  - Can try it any time
- Plants with large roots
  - Cut pieces of root 2” – 6” long.
  - Store at 40 degrees for 3 weeks in moist sawdust, peat moss or sand
  - Plant horizontal about 2-3” below soil surface
- Plants with small roots
  - Cut pieces of root 1” – 2” long
  - Plant horizontal about ½” below soil surface
  - Keep evenly moist till shoots emerge

Leaf cuttings

Mostly for house plants and tropicals (e.g. African violet, begonia)

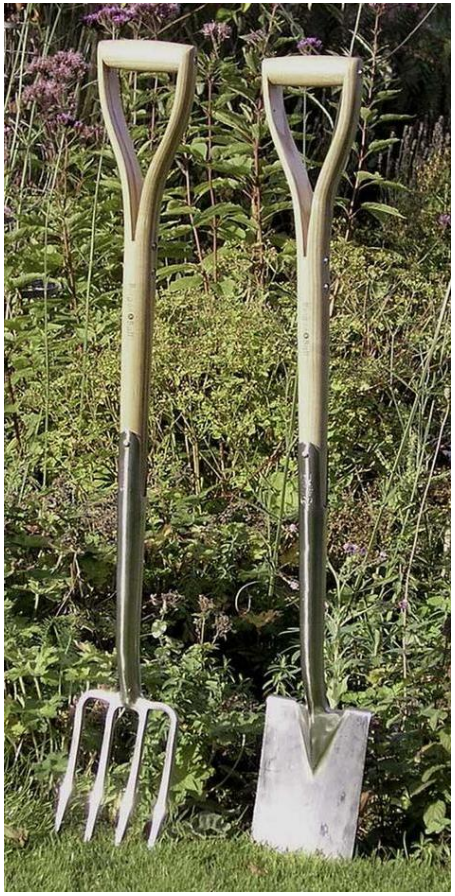
Leaf-petiole
(African violet)

Leaf blade
(Jade plant)

Leaf vein
(Rex begonia)

From http://www.hort.purdue.edu/ext/ho-37web.html

Tools



Garden spade
- Dig plants out of the ground without disturbing their neighbors
- Divide plants

Pull-stroke pruning saw, blade length 4”-7”
- Divide plants
- Trim root-bound plants
- Dig up stumps

Bypass pruners
- Trim broken roots and stems
- Take cuttings

Garden fork
- Pry plants out of the ground with most of their roots
- Divide plants (need 2)

Reciprocating saw
- Divide plants in ground or out

Sources

- Propagation lecture series
  - http://www.ndsu.edu/pubweb/chiwonlee/plsc368/lecture/chap1.htm
  - http://www.ces.ncsu.edu/hil/hil-8700.html
  - Michael Dirr, The Reference Manual of Woody Plant Propagation
  - Dr. Leonard Perry, Herbaceous Perennials Production: A Guide from Propagation to Marketing
- Dividing perennials
  - http://www.clemson.edu/extension/hgic/plants/landscape/flowers/hgic1150.html
- List of what cuttings work for which annuals and perennials
  - http://aggie-horticulture.tamu.edu/faculty/davies/pdf%20stuff/ph%20final%20galley/M21_DAVI4493_08_SE_C21.pdf
  - http://pss.uvm.edu/ppp/proptabA.htm
- List of what cuttings work for trees and shrubs
  - Michael Dirr, Manual of Woody Landscape Plants
  - Debbie Lonnee, Nancy Ross, Don Selinger, and John Whitman, Growing Shrubs and Small Trees in Cold Climates

Questions?