

Ernesto Sandoval

UC Davis

Botanical Conservatory

Plant Hormones

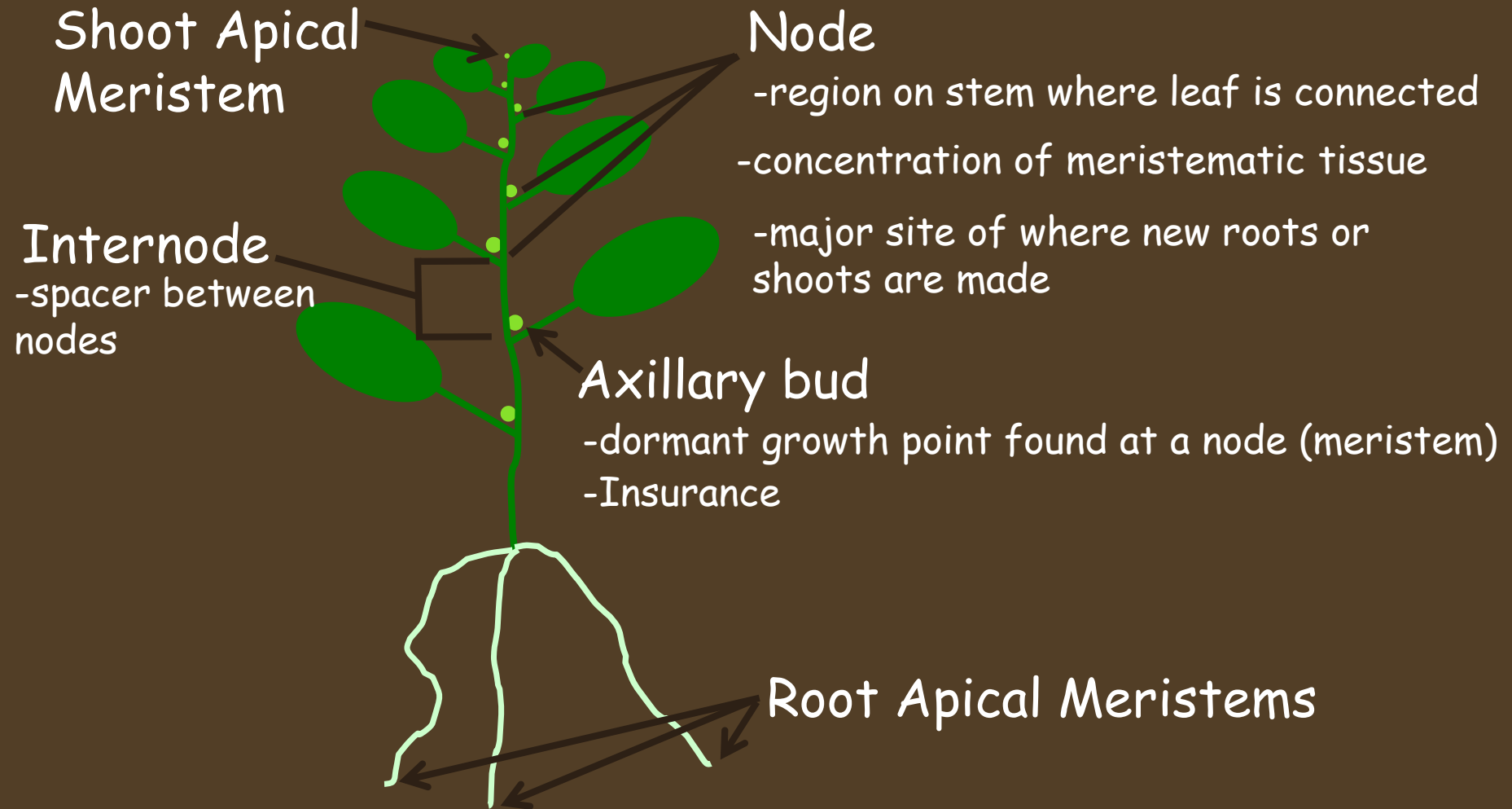
How and why they work!

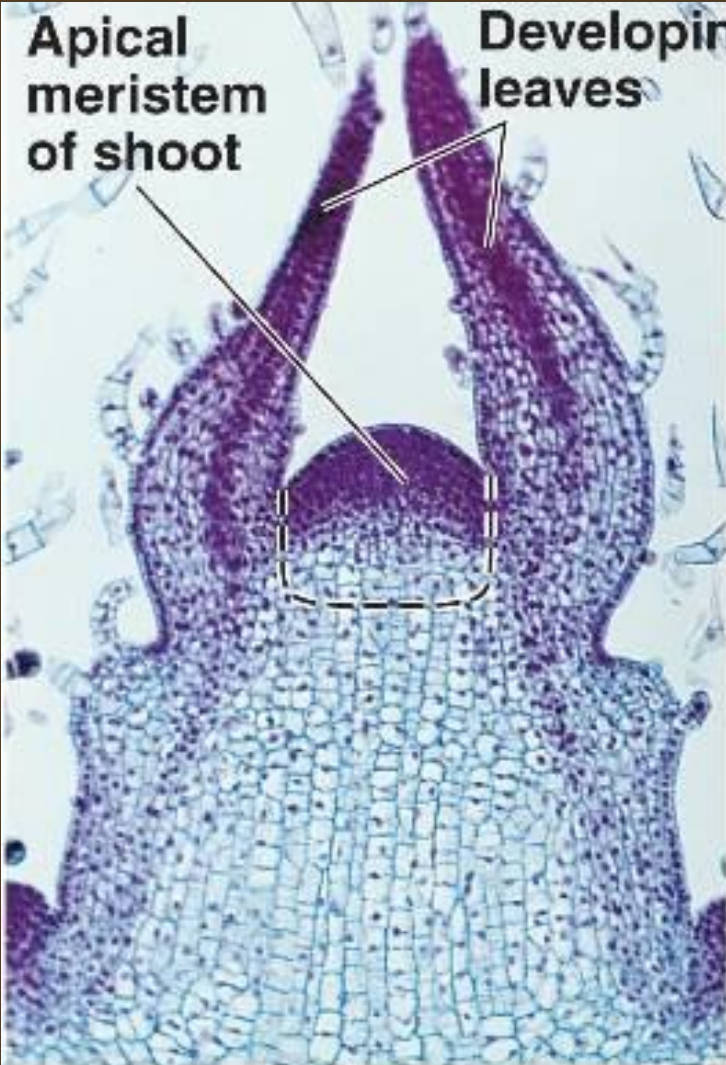
Growth and Propagation



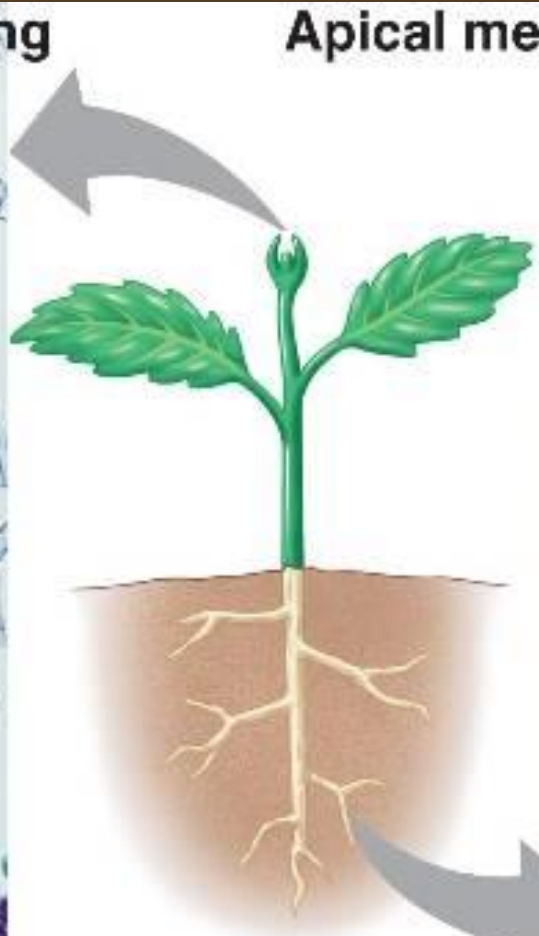
Meristem

- Region of undifferentiated cells capable of being convinced to grow into something
- Why do plants have meristems?
- Insurance; replace what will be damaged!



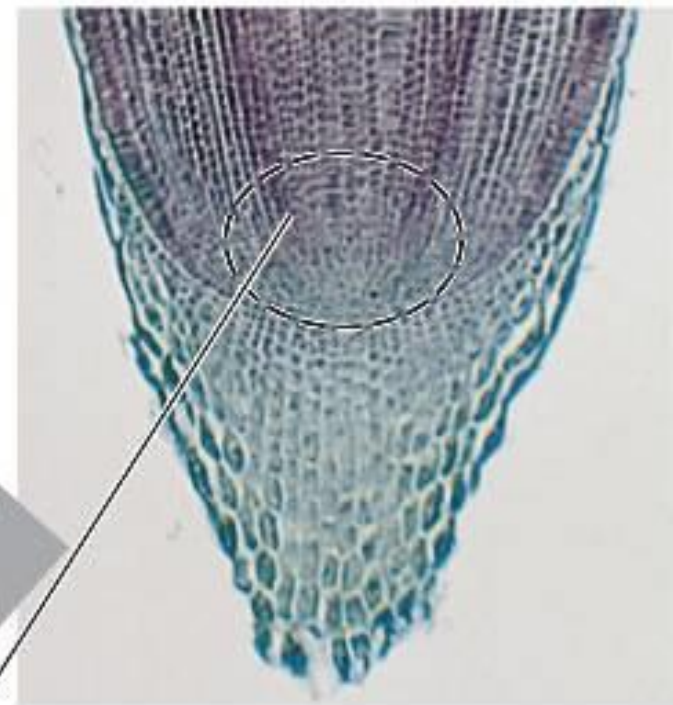


Shoot 100 μm



Apical meristems

Apical meristem of root



Root 100 μm

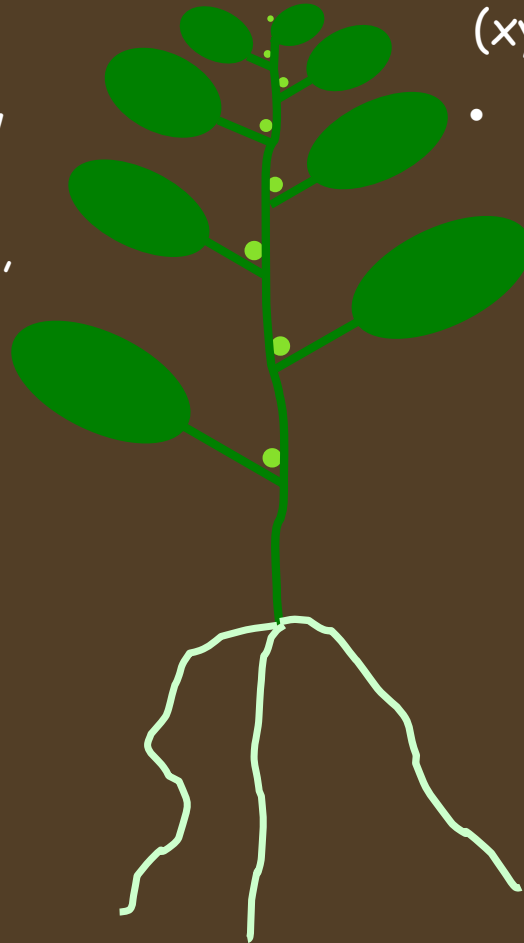
Auxins

- Produced at active/growing Shoot meristems & young leaves
- Travel towards roots and with gravity
- Move in sugar transport tissue (phloem)
- Inhibit axillary bud growth
- Promote root growth at low concentrations
- Synthetic forms IBA, NAA, IAA and ??

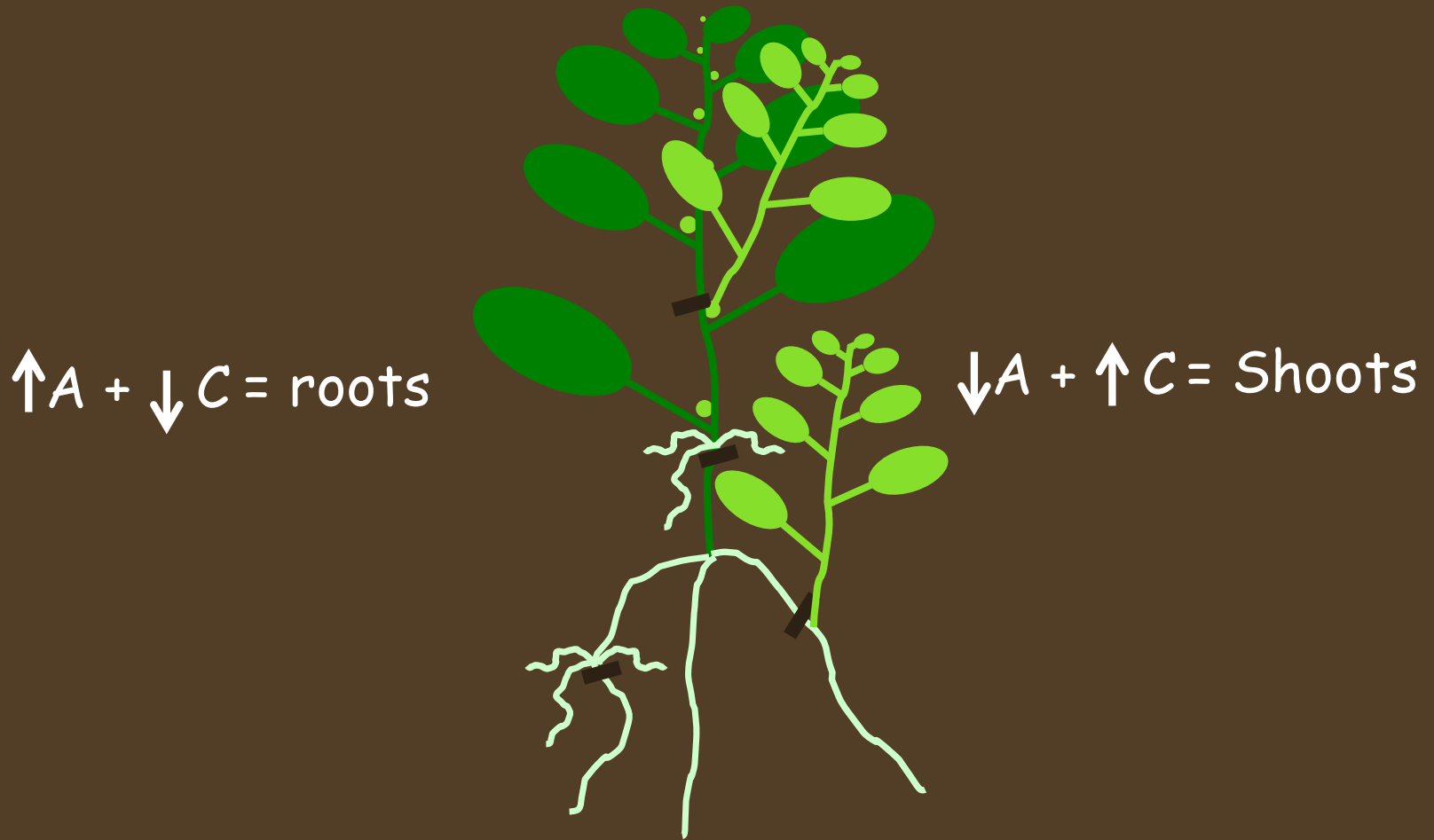
Two major Hormones

Cytokinins

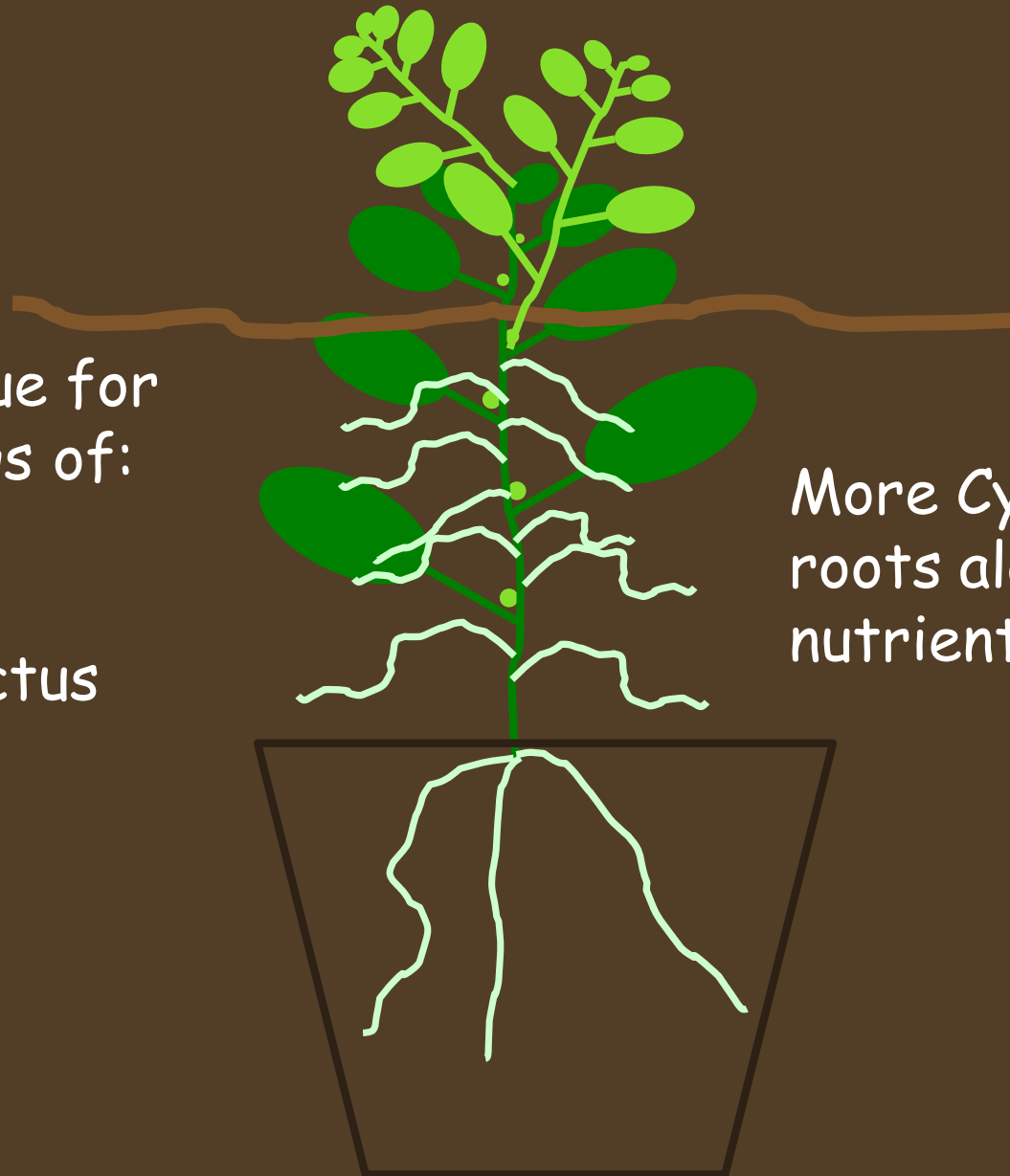
- Produced at active/growing Root meristems
- Travel towards shoots and leaves
- Move in water transport tissue (xylem)
- Promote axillary bud growth
- Keiki paste
Cytokinin in lanolin



What happens when you prune plant parts?



Hormonally, why should you bury a Tomato plant deeper?



Good technique for
Making cuttings of:
Mints
Stapeliads
Christmas cactus
And...

More Cytokinin from
roots along with more
nutrients and water!!



Cyrtanthus spiralis

Cyrtanthus spiralis
bulb rotted
led to branching



Aloe pillansii propagation Addition of Cytokinin



March 11, 2011



May 13, 2011

Various treatments



Aloe pillansii
Liliaceae
152008.197
wedge/cut - cytokinin in application on axillary buds and apical bud (via wedge) white out - neck side
Drew Champion

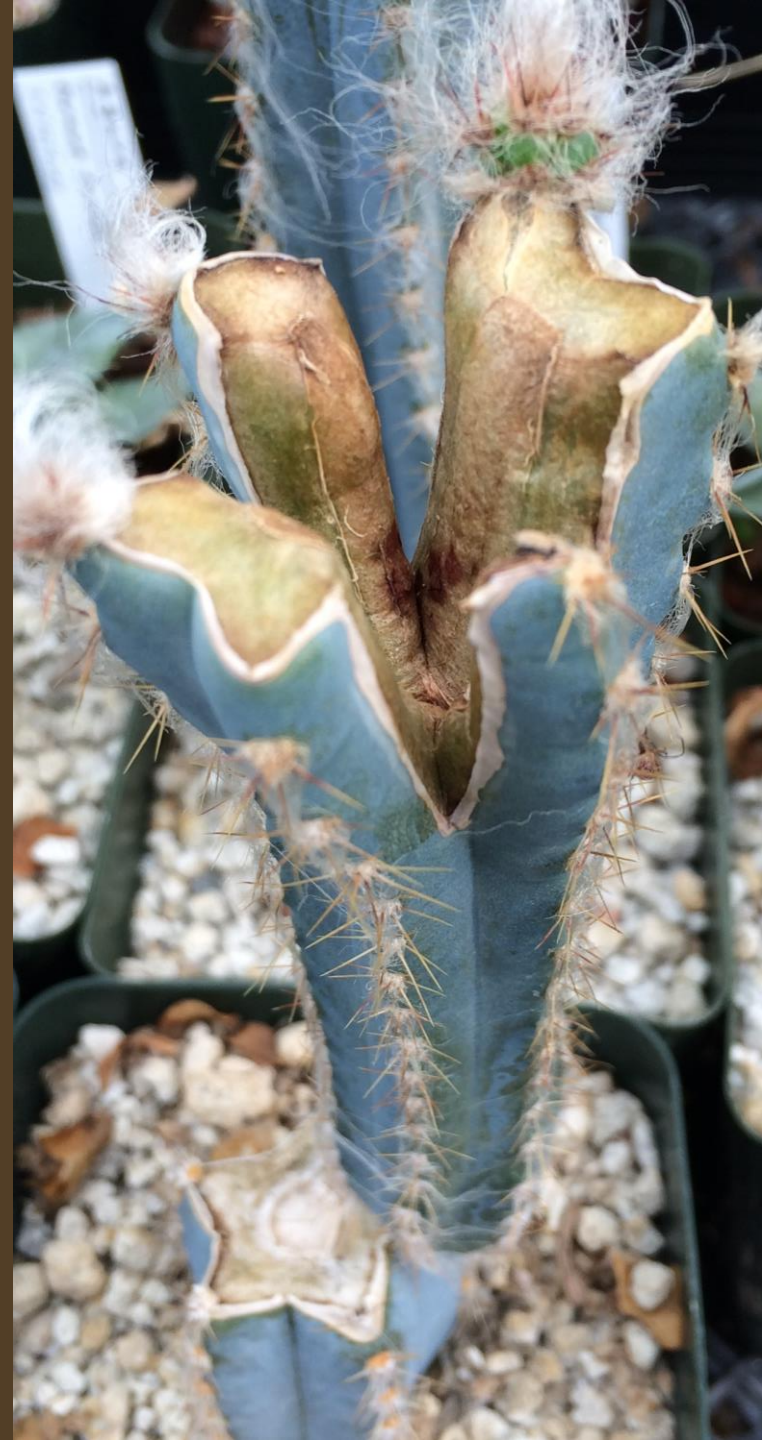
wedge/cut - cytokinin Application to axillary buds - white out - neck side
Drew Champion

Aloe pillansii
Liliaceae
152008.197
wedge cut 2x = quarters plant No Hormone
Drew Champion



Pilosocereus glaucochrous

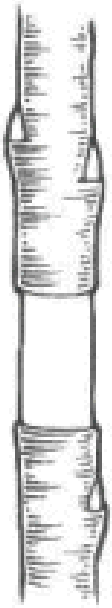
split through meristem
to promote branching



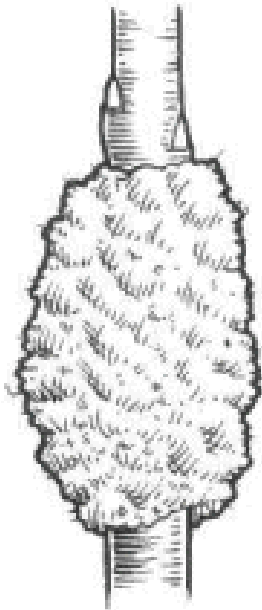
Agave victoriae-reginae variegated form



Air layering



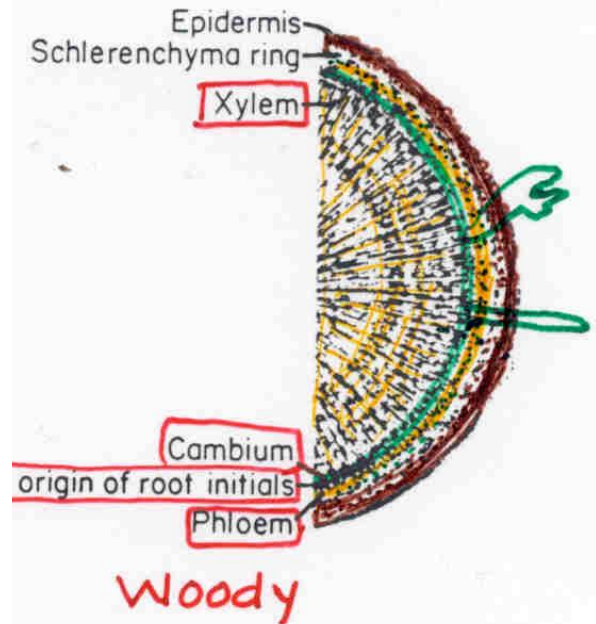
The stem is girdled to induce root formation above the cut.



The girdled stem is covered with damp moss.

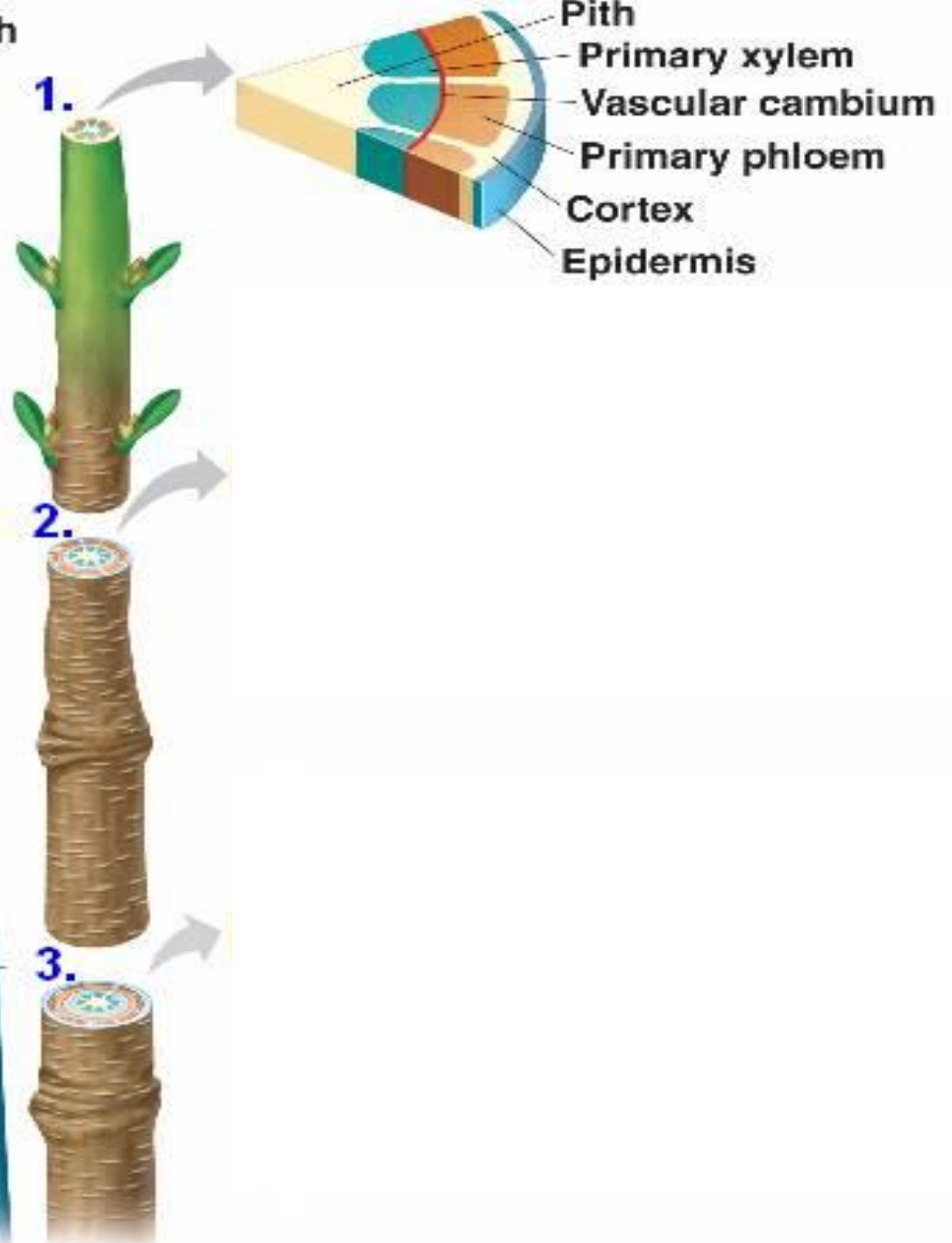
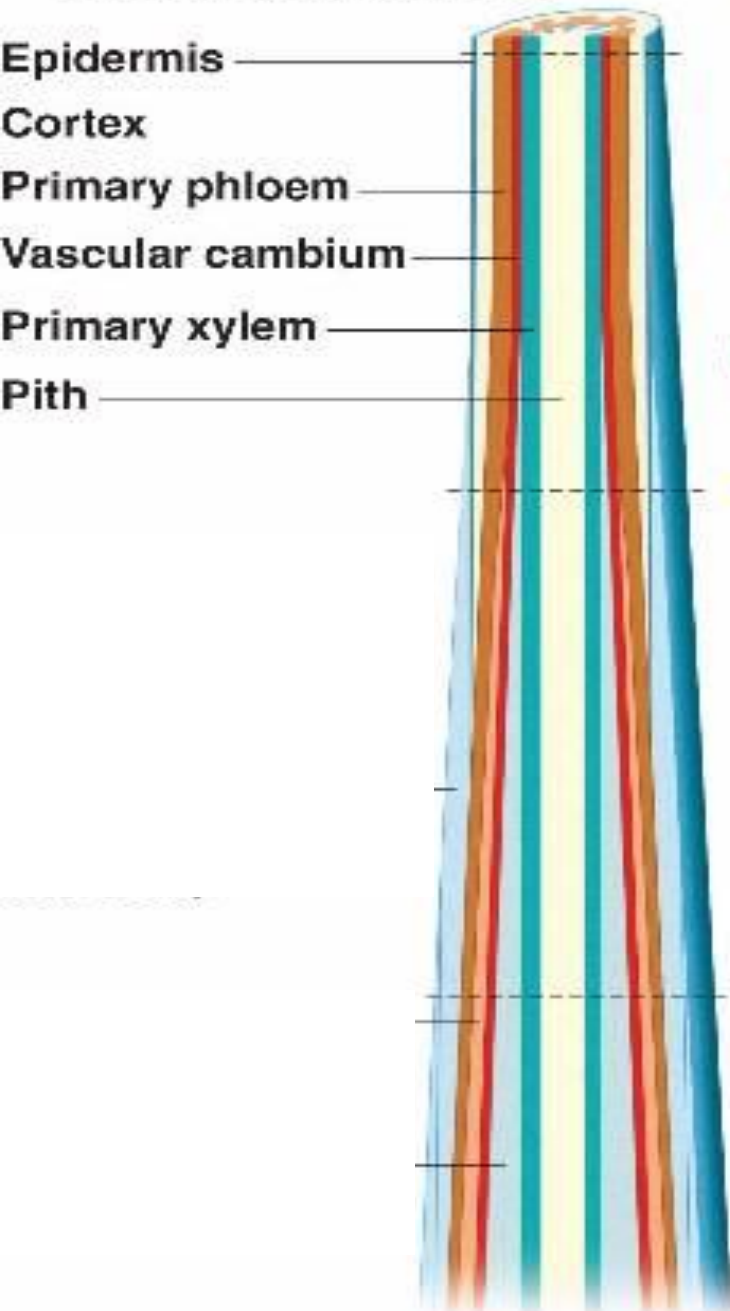


Aluminium foil or plastic sheeting is wrapped around the moss and tied at both ends. This cover is removed 2-3 months after tying or when the roots can be seen.



Stem Cross Sections Showing the Sites of Adventitious Root Formation

Primary and secondary growth in a two-year-old stem





Aztekium hintonii
a desert cactus
grafted onto
a rainforest cactus
Pereskia



Grafted
*Epithelantha
micromeris*
and *Strombocactus*

Astrophytum asterias seedling variation



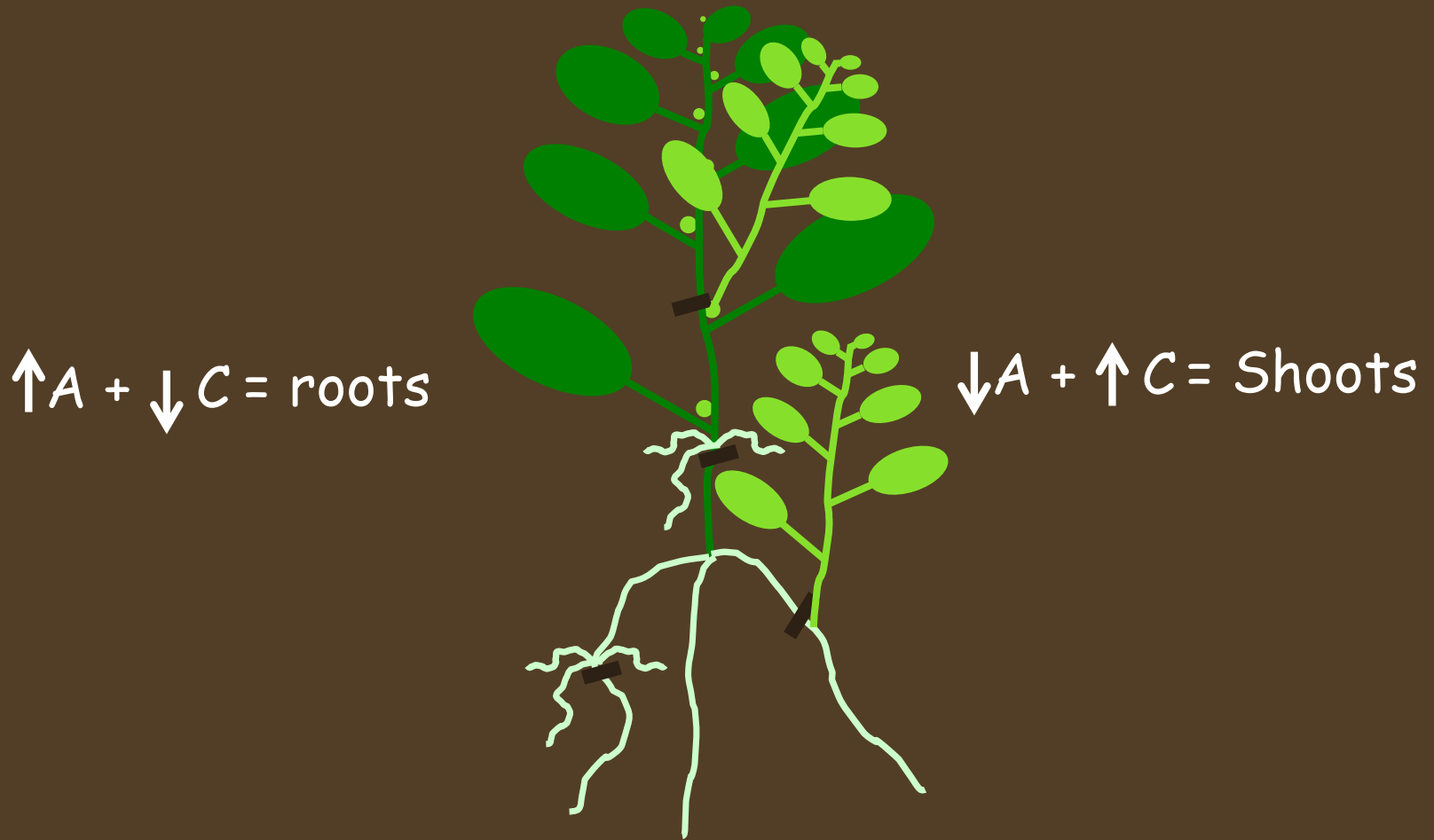
Germinated 9-17-02

Grafted 11-13-02

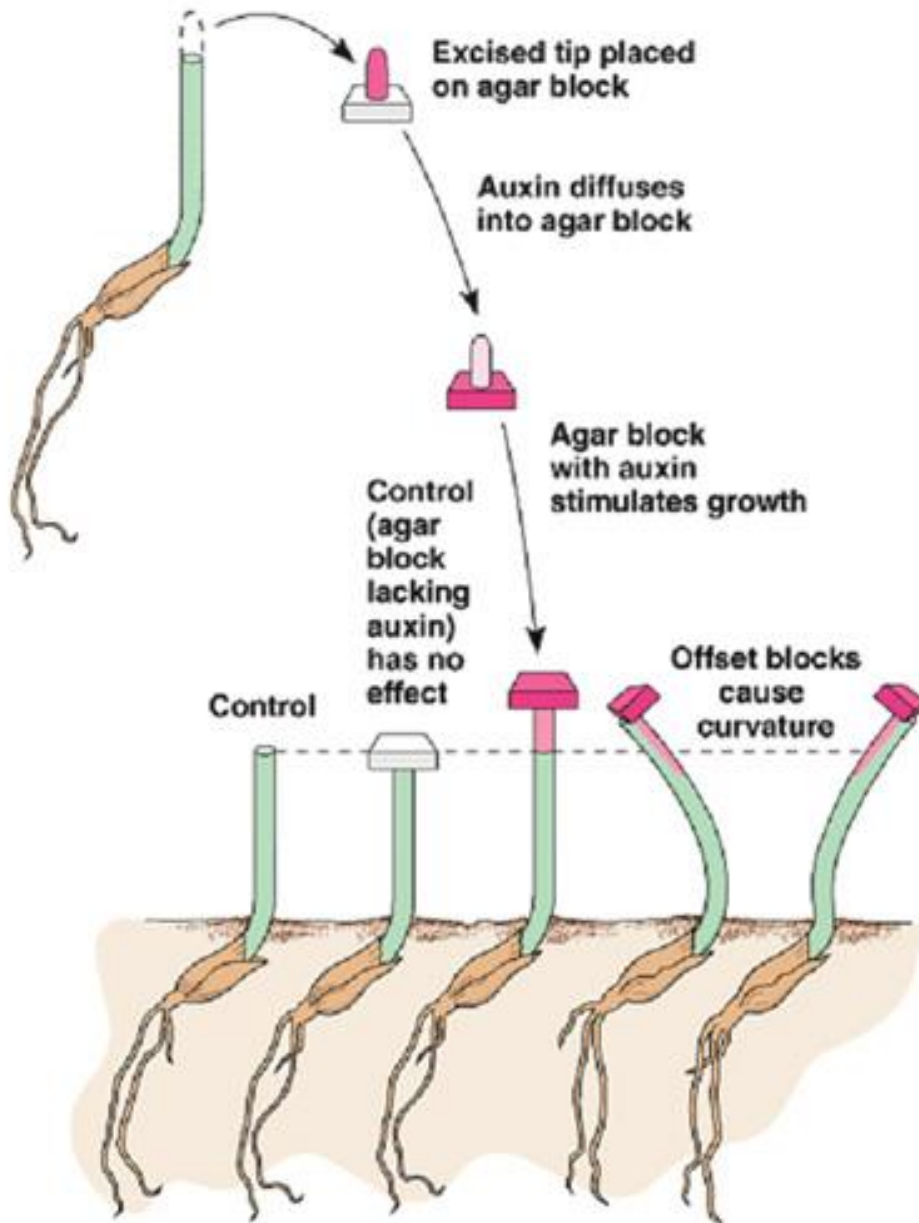
Flowered 9-15-03



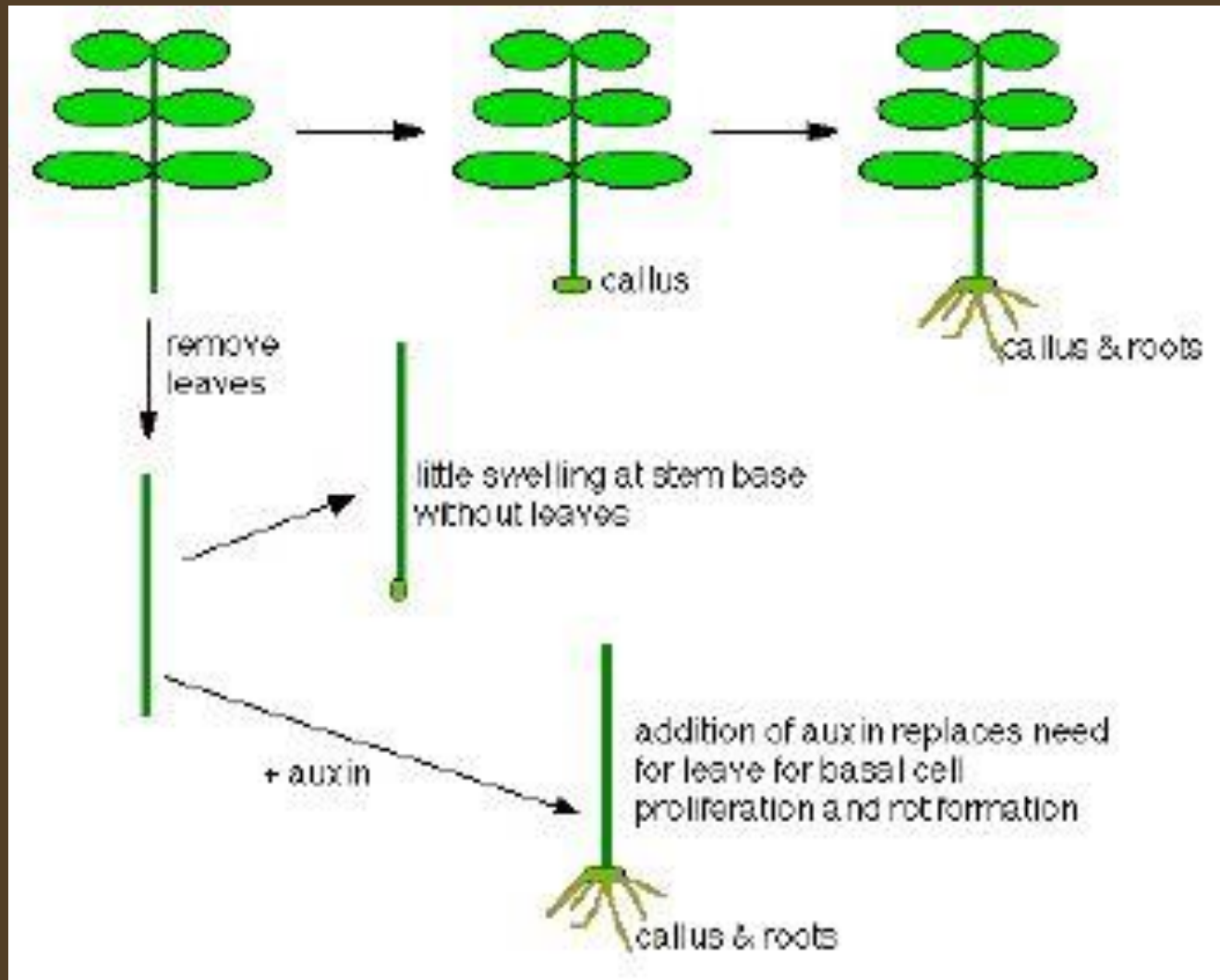
What happens when you prune plant parts?



Auxin and Plant Growth



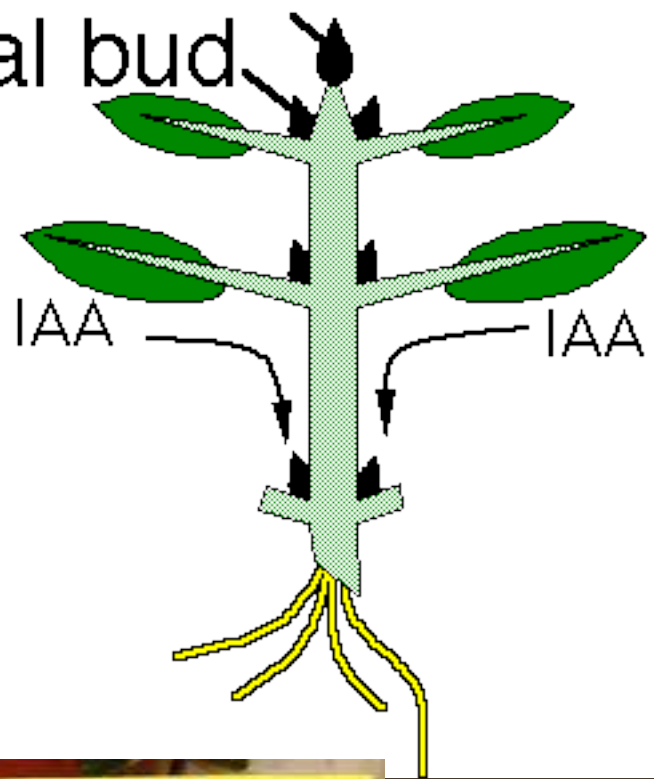
Stem Cutting research



The Importance
of young leaves
and meristems
for better root
production



apical bud
lateral bud

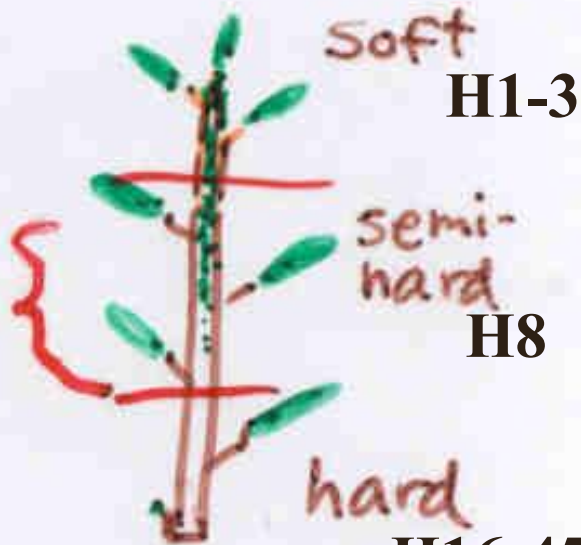


Rooting aided by Hormones
(forms of Auxins)

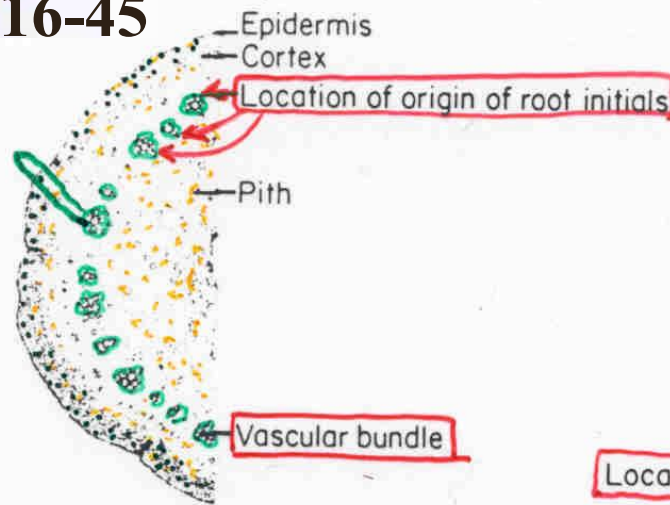


- Hormex IBA
H1% ,3 ,8 and H16, 30, 45
- Rootone F
NAA or NAD at 1-2%
plus fungicide

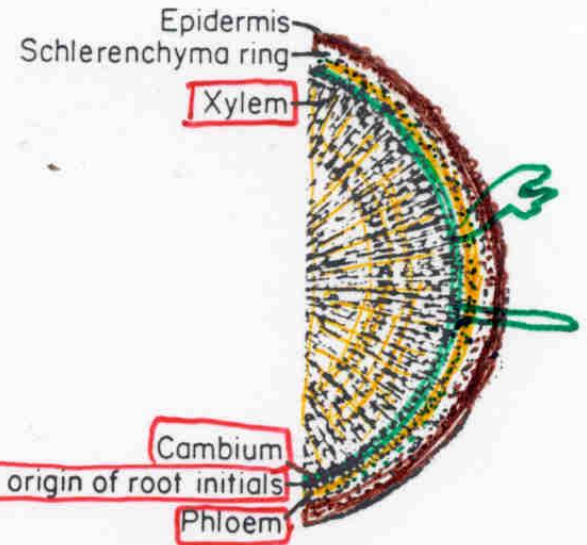
Treatments for making Stem cuttings and getting roots



H16-45



Herbaceous

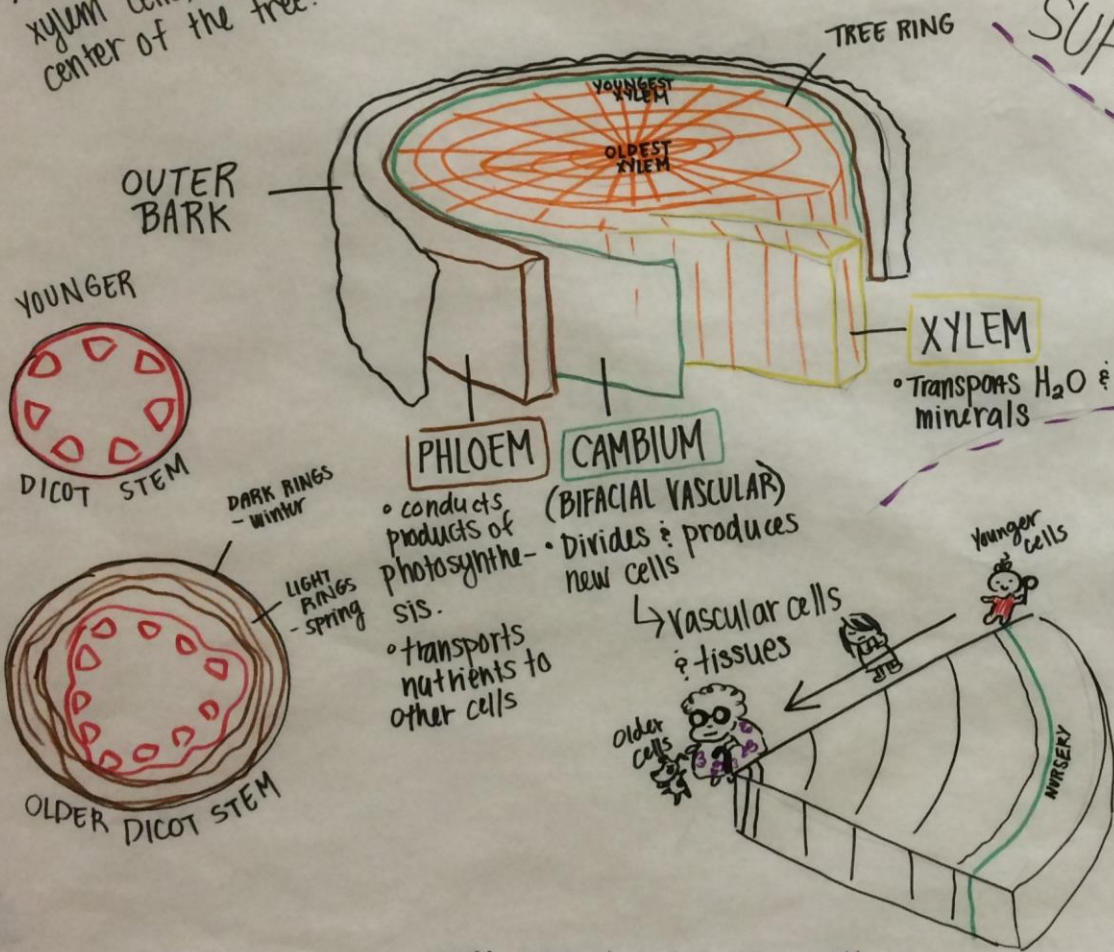


Woody

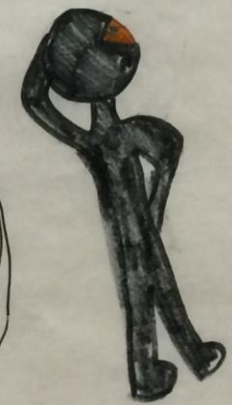
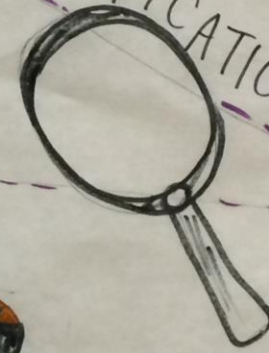
Stem Cross Sections Showing the Sites of Adventitious Root Formation

Secondary Growth

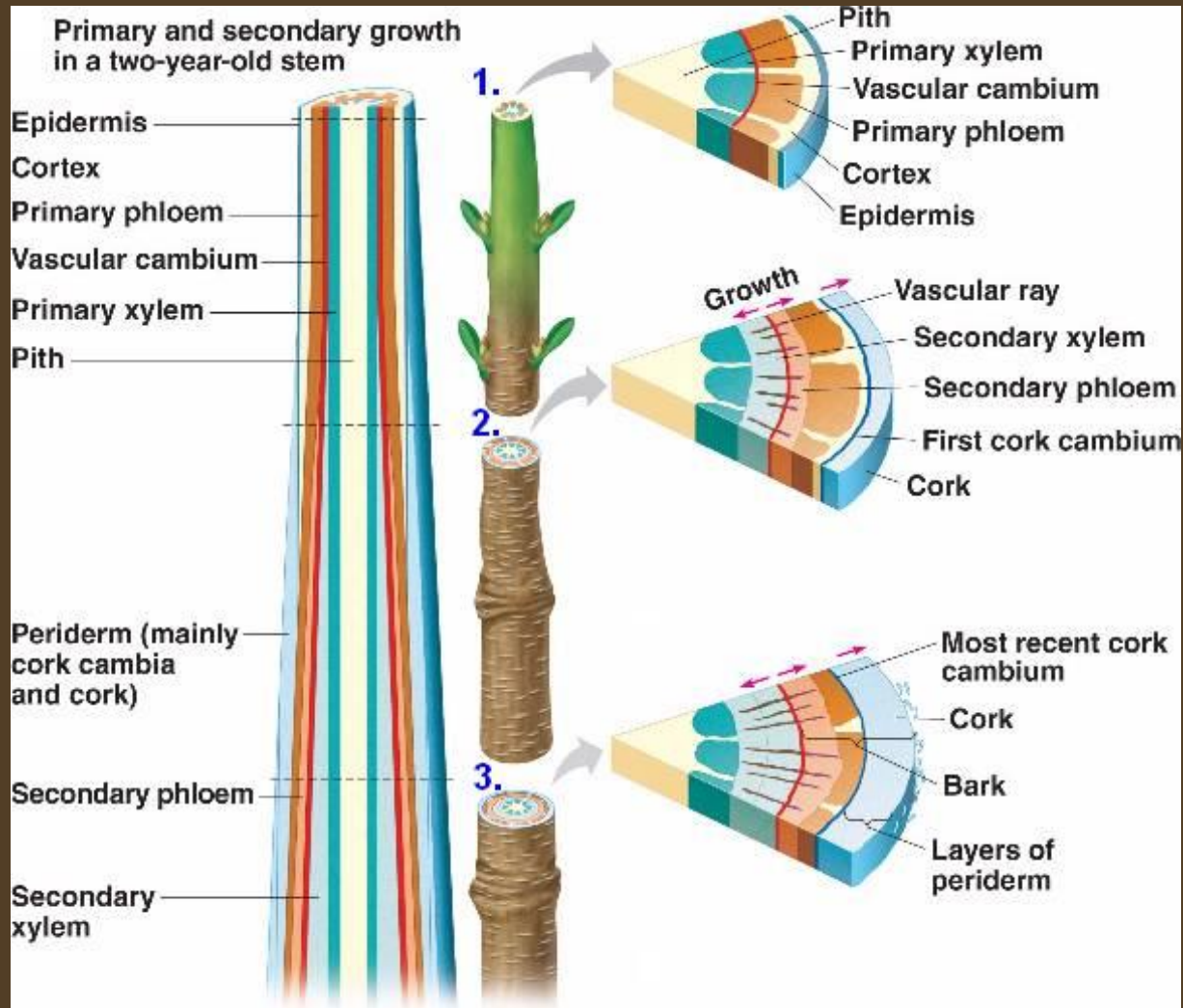
As the bifacial vascular cambium produces new xylem cells, the new cells push older cells towards the center of the tree.



SUPER MAGNIFICATION!



Agave victoriae-reginae variegated form



Zamioculcas zamiifolia leaf propagation



EZ- Clone aeroponic propagation chamber



Great for “Hydroponic Tomatoes” and much much more
3x faster than mist bench rooting!



Vegetative Propagation
How to do it?

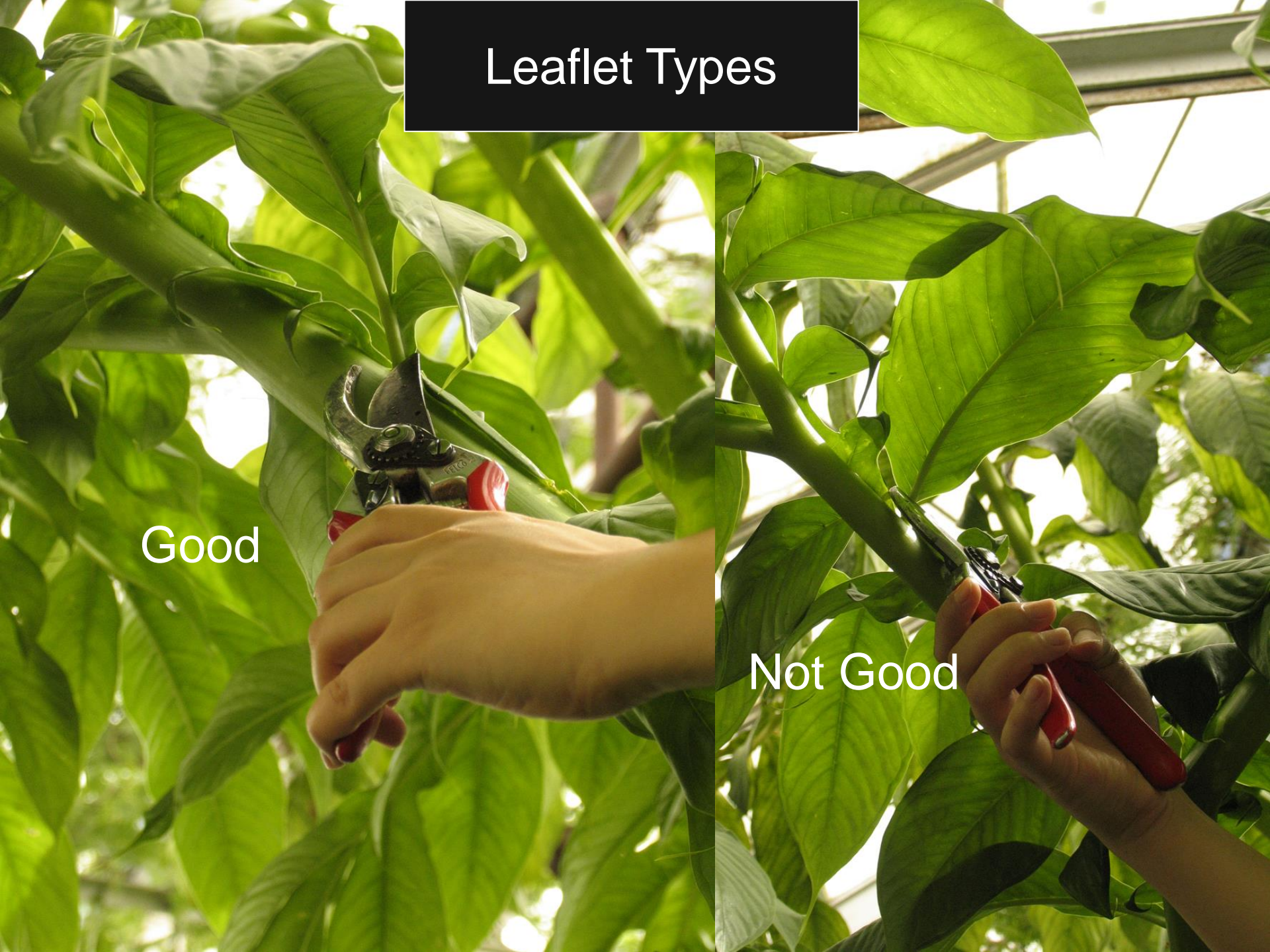
leaflets from
young/fresh/new leaf



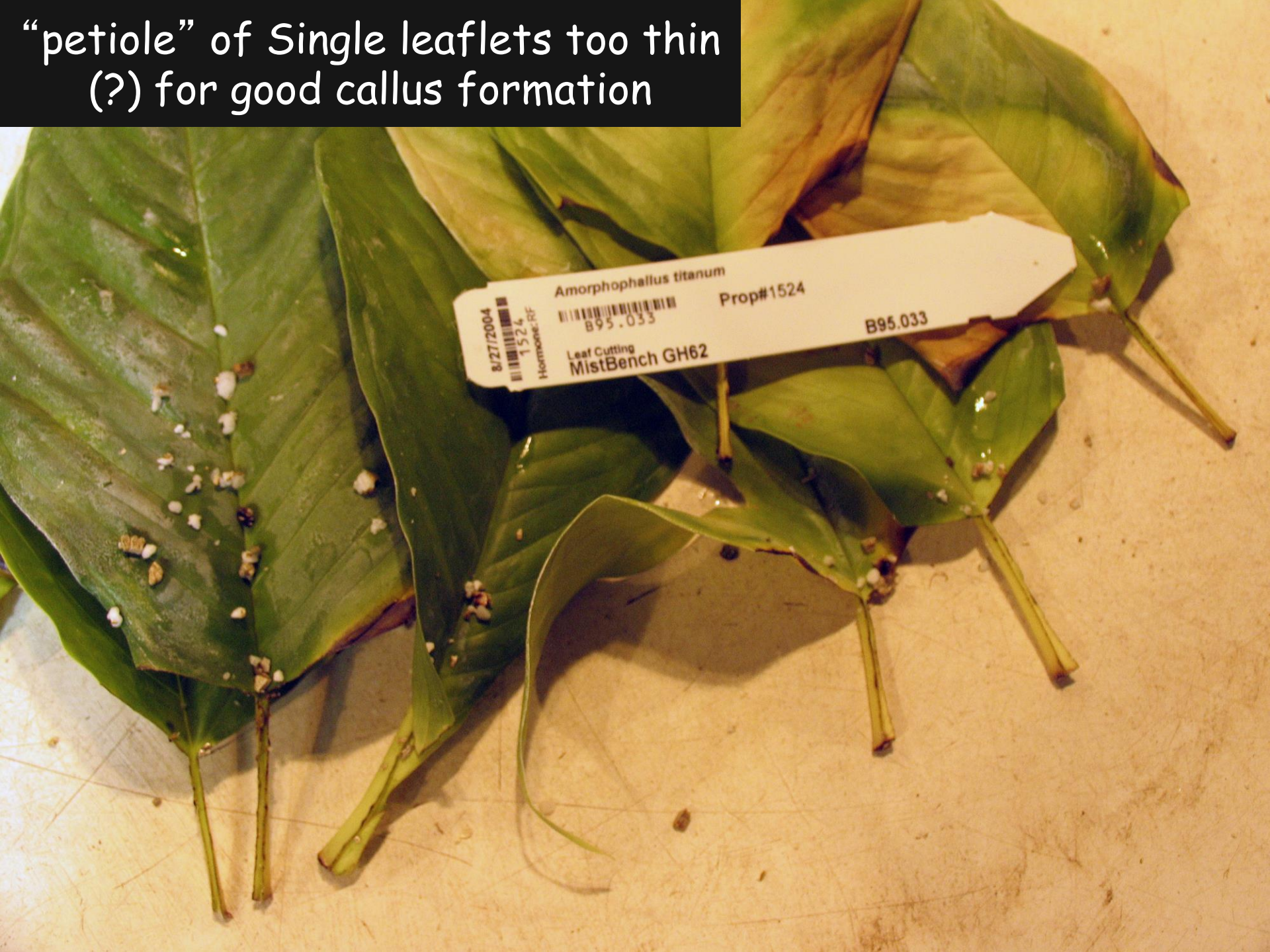
Leaflet Types

Good

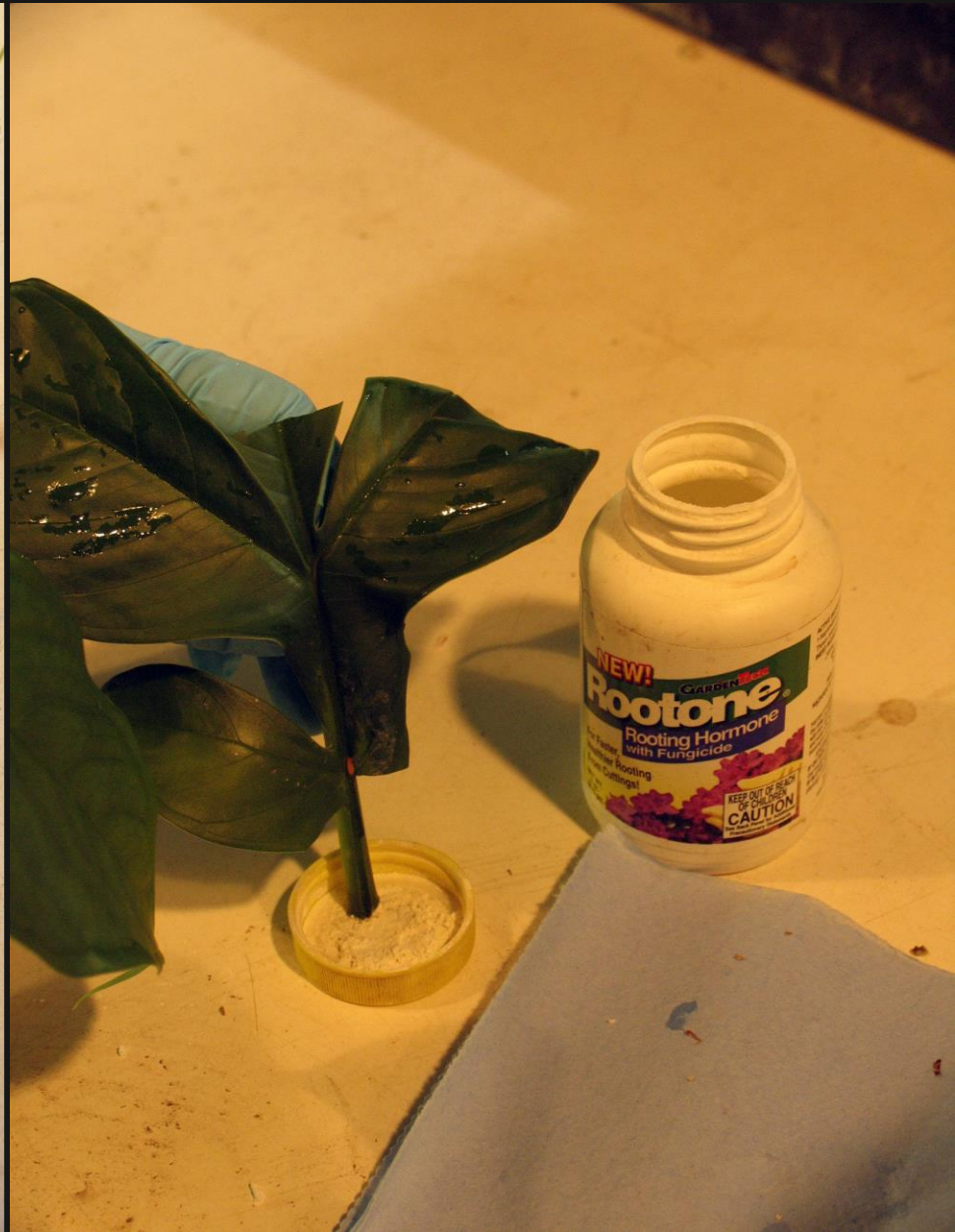
Not Good



“petiole” of Single leaflets too thin
(?) for good callus formation



“petiole” of Leaf portion should be about the thickness of a sharpie (1-1.5cm) for good callus formation



Removal of leaflet
base for insertion into rooting
media



Mist Bench Ready Cuttings

- Planted upright in pre-moistened vermiculite/perlite
- Pen or marker used to poke hole (avoid removal of hormone)
- large humidity chamber as alternative



Bottom heated (75F) Automatic misting bench



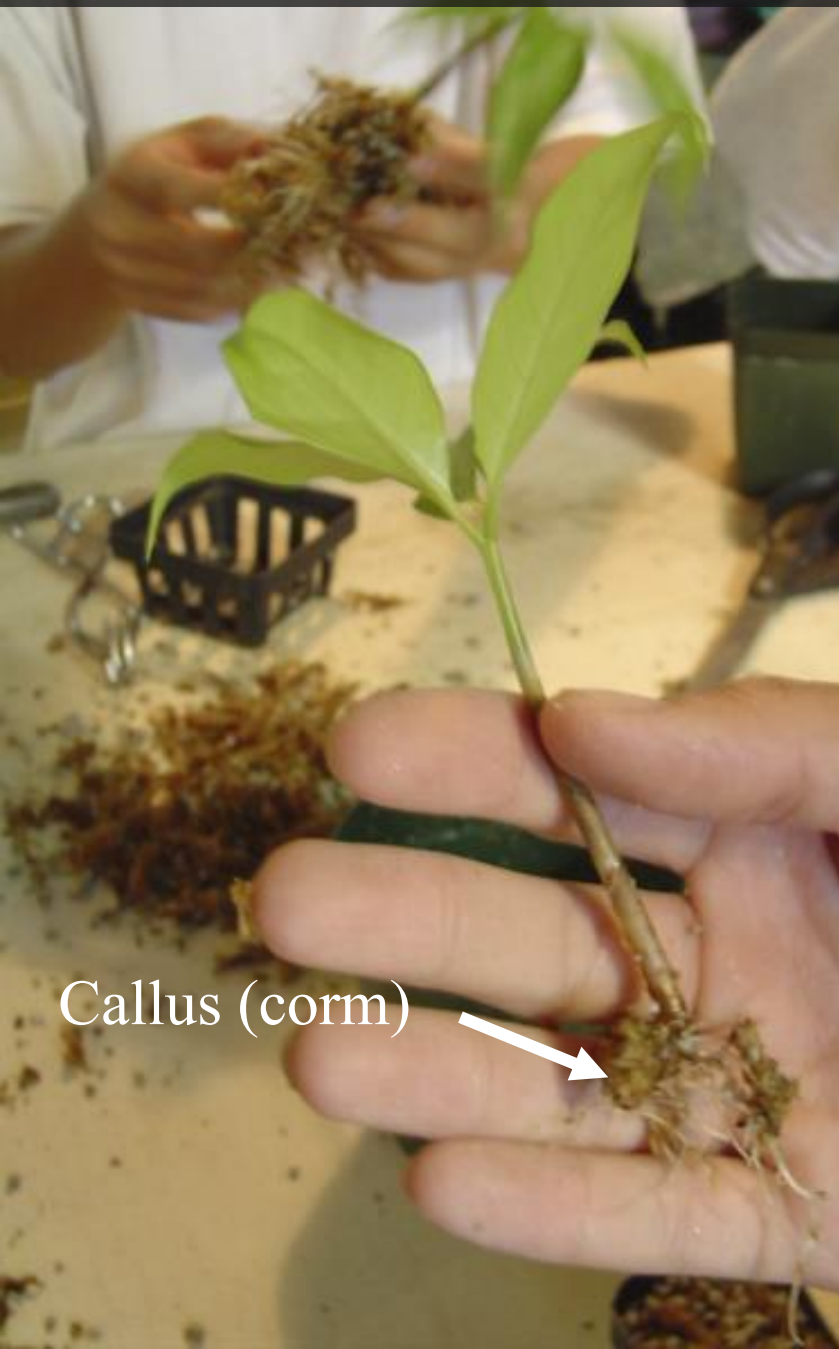
Early stage of callus formation
(swelling of leaflet base)
after 1 month under mist



7 months



From small leaflet



From larger leaflet





Lachenalia leaf
cuttings



Leaf cuttings of *Haworthia comptoniana*



Leaf cutting of *Haworthia bayeri*



B2013.072 *Haworthia*
10/17/2013

Sansevieria kirkii leaf cuttings (made 10/13)



Gasteria
acinacifolia
leaf
cutting



Functions of Auxins: <http://www.plant-hormones.info/>

- Stimulate cell elongation
- Stimulate cell division in the cambium and, in combination with cytokinins in tissue culture
- Stimulate differentiation of phloem and xylem
- Stimulate root initiation on stem cuttings and lateral root development in tissue culture
- Mediates the tropistic response of bending in response to gravity and light
- The auxin supply from the apical bud suppresses growth of lateral buds
- Delays leaf senescence
- Can inhibit or promote (via ethylene stimulation) leaf and fruit abscission
- Can induce fruit setting and growth in some plants
- Involved in assimilate movement toward auxin possibly by an effect on phloem transport
- Delays fruit ripening
- Promotes flowering in Bromeliads
- Stimulates growth of flower parts
- Promotes (via ethylene production) femaleness in dioecious flowers
- Stimulates the production of ethylene at high concentrations

Functions of Cytokinins :

- Stimulates cell division.
- Stimulates morphogenesis (shoot initiation/bud formation) in tissue culture.
- Stimulates the growth of lateral buds-release of apical dominance.
- Stimulates leaf expansion resulting from cell enlargement.
- May enhance stomatal opening in some species.

Auxins

- Produced at active/growing Shoot meristems & young leaves
- Travel towards roots and with gravity
- Move in sugar transport tissue (phloem)
- Inhibit axillary bud growth
- Promote root growth at low concentrations
- Synthetic forms IBA, NAA, IAA and ??

Ethylene

- Promotes ripening, cell maturation and death
- Produced in leaves that use more sugar than they produce

The major Hormones



Cytokinins

- Produced at active/growing Root meristems
- Travel towards shoots and leaves
- Move in water transport tissue (xylem)
- Promote axillary bud growth
 - Keiki paste
 - Cytokinin in lanolin

Giberellins

- Produced through out the plant
- Broken down by sunlight
- Promote cell elongation (stretching)
 - Promote seed germination
 - Bonzi (Paclobutrazol)
 - -inhibits GA synthesis

What Gibberellins do:

- Stimulate stem elongation by stimulating cell division and elongation.
- Stimulates bolting/flowering in response to long days.
- Breaks seed dormancy in some plants which require dormancy stratification or light to induce germination.
- Induces maleness in dioecious flowers (sex expression).
- Can cause parthenocarpic (seedless) fruit development.
 - Grapes
- Can delay senescence in leaves and citrus fruits.

Functions of Ethylene:

- Stimulates the release of dormancy.
- Stimulates shoot and root growth and differentiation (triple response)
- May have a role in adventitious root formation.
- Stimulates leaf and fruit abscission.
- Stimulates Bromiliad flower induction.
- Induction of femaleness in dioecious flowers.
- Stimulates flower opening.
- Stimulates flower and leaf senescence.
- Stimulates fruit ripening.

The End

Ernesto Sandoval
Director

UC Davis Botanical Conservatory
jesandoval@ucdavis.edu

Growth...to be continued!