Use these notes as the framework for your own notes. Annotate each diagram and include additional details to aid your understanding using Kognity, Oxford and Weebly. Include definitions and explanations where necessary.

**Plant Growth at Meristems**

* Unlike animals, plants have indeterminant growth.
* Regions from which a plant can grow are called “meristems.”
* Meristems have cells that are totipotent.
* There are two types of meristems:



* Causes secondary growth (widening of plant)
* Located in the stem cambium
* Produces cork and bark
* Causes primary growth (up and down, length)
* Located at tips of shoots and roots
* Produces new leaves, flowers and roots



* Growth at meristems is caused by two factors:
1. Cell enlargement
2. Cell division (mitosis and cytokinesis)



* When mitosis occurs in the meristem, each daughter cell has a different fate

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|  | Differentiation to give rise to specialized structures (leaves, flowers, roots) |



* In the stem, growth occurs at meristem tissue located at nodes (junctions) with the remaining meristem tissue forming an inactive “auxiliary bud.”
	+ Auxiliary buds have the potential to form branching shoots.

**Plant Hormones: *Auxin***

* Hormones are:
* Auxins are type of plant hormone that influences cell growth rates by changing gene expression.
	+ Gene expression is…
	+ Gene expression is studied via microarray analysis.

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| Molecular Biology research evolves through the development of the technologies used for carrying them out. It is not possible to research on a large number of genes using traditional methods. DNA Microarray is one such technology which enables the researchers to investigate and address issues which were once thought to be non-traceable. One can analyze the expression of many genes in a single reaction quickly and in an efficient manner. DNA Microarray technology has empowered the scientific community to understand the fundamental aspects underlining the growth and development of life.A typical microarray experiment involves the hybridization of an mRNA molecule to the DNA template from which it is originated. Many DNA samples are used to construct an array. The amount of mRNA bound to each site on the array indicates the expression level of the various genes. This number may run in thousands. All the data is collected and a profile is generated for gene expression in the cell. |

* Auxin has different effects with different concentrations.



* Auxin production in the shoot apical meristem

“APICAL DOMINANCE”

* + Promotes…
	+ Prevents…
	+ “Pruning”





* The distribution of auxin can be changed within the plant by altering the location of auxin transport proteins in the plant cell membrane.
	+ “Efflux” proteins are transport molecules OUT of a cell.
	+ PIN proteins are integral membrane proteins that are involved in the transport of auxin out of the cell.
	+ PIN proteins can be located along specific sides of the plant cell, thereby directing the direction of auxin movement (and in turn determining which region of the plant will grow).
	+ PIN proteins can change position within the membrane.
* Auxin’s mechanism of action is different in shoots and roots as different gene pathways are activated in each tissue
	+ In the shoots, auxin stimulates cell elongation and thus high concentrations of auxin promote growth (cells become larger)
	+ In the roots, auxin inhibits cell elongation and thus high concentrations of auxin limit growth (cells become relatively smaller)

**Tropisms**

* Tropism definition:

* + Phototropism:
	+ Gravitropism:



**In phototropism**, light receptors (phototropins) trigger the redistribution of auxin to the dark side of the plant.

* Remember, in shoots auxin stimulates cell growth. So, the dark side of the shoot elongates and shoots grow towards the light.



**In geotropism,** auxin will accumulate on the lower side of the plant in response to the force of gravity

**Micropropagation**

* Definition:
* Key steps:
* Meristem plant tissue is selected from a stock plant.
	+ The meristem cells are totipotent, so…
	+ The removed tissue is called the “explant”
* The explant tissue is grown on sterile nutrient agar and treated with growth hormones to stimulate growth
	+ More auxin …
	+ More cytokinin (a different plant hormone)…



* Uses of micropropagation:

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| **Rapid Bulking*** Desirable stock plants can be cloned to maintain a selected characteristic
* More reliable that selective breeding because new plants are genetically identical to the parent “stock” plant
* Also used to rapidly produce large quantities of plants created via genetic modification
 | **Virus-Free Strains*** Plant viruses have the potential to decimate crops, crippling economies and leading to famine
* Viruses typically spread through infected plants via the vascular tissue – which meristems do not contain
* Propagating plants from the non-infected meristems allows for the rapid reproduction of virus-free plant strains
 | **Propagation of Species*** Used to increase numbers of rare or endangered plant species
* Used to increase numbers of species that are difficult to breed sexually (e.g. orchids)
* Used to increase numbers of plant species that are commercially in demand
 |

* Plant propagation from stem cutting
	+ How to prepare a plant for rooting of a stem cutting:



* List potential manipulated, responding and controlled variables in an experiment of rooting stem-cuttings.

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| --- | --- | --- |
| MANIPULATED | RESPONDING | CONTROLLED |

**Natural Cloning in Plants**

* Clones are:
* In plants, clones form through vegetative propagation:
* Virtually all types of roots and shoots are capable of vegetative propagation
	+ Garlic and onion bulbs are modified plant **leaves** – all the bulbs in a group are genetically identical
	+ Underground **stems** (e.g. potato tubers) can form new plants which are genetically identical to the parent plant
	+ Certain plants can form horizontal **stems** called runners (or stolons) that grow roots and develop into clones