

## Topic 06

**The Market Place & Plant Modifications:**  
**An application of your botanical knowledge.****A. Introduction to Plant Modifications & the Market Place**

You have fastidiously examined the structure and growth of the organs of plants in the previous labs. With this background, we ask you to first examine and interpret selected examples of modifications of these organs and then, in part H, to interpret structures taken from the supermarket. This should provide lots of fodder for dinnertime or grocery store conversations. All can be interpreted using the terms you have been learning regardless of how bizarre they may look to you.

Use your own powers of deduction, your textbook and any available supplemental sources to answer the questions that accompany each exhibit.

An outline for today's lab is below. The meat and, today, the POTATOES of the lab start on page 2.

**B. Modified Leaves****C. Modified Stems****D. Modified Shoots****E. Interesting Roots****F. Succulence****G. Armed Plants****H. Market Place**

*Opuntia weintiana*  
(Venezuela).  
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Michelangeli

## **B. Modified Leaves**

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Leaves are commonly “modified” from their usual function in capturing light rays for photosynthesis. There are many possibilities, some of which you may see today. Some common modified leaf homologs include:

**SUCCULENT LEAF** = Where the leaf is fatter than normal, possessing extensive water-storage parenchyma internally.

Various **FLORA ORGANS** such as **SEPALS**, **PETALS**, **STAMENS**, and **CARPELS**, are all **HOMOLOGS** of leaves.

**BRACT** = a leaf, reduced in size and typically not as green or photosynthetic as its full-on vegetative counterpart. Often subtending flowers and inflorescences, sometimes on horizontal stems.

**SHEATHING LEAF** = leaves sometimes sheathe the stem at their base for some length before ending at the node. These sheaths are sometimes tubular.

In some epiphytic rainforest plants called **TANK EPIPHYTES**, the overlapping leaves are separated by such short internodes that they effectively form a tank in which water and leaf or animal matter collects.

**SHEATH LEAF** = a leaf that does not have a petiole or blade, and simply ensheathes the stem (e.g., those on a young bamboo shoot).

**SCALE** = very small, thin, and non-photosynthetic; often on subterranean stems such as rhizomes, or the “bud scales” of winter buds on trees and shrubs.

**SPINE** = a sharp, pointy leaf homolog (what type of tissue makes these hard?)

**SPINY margins** = when the margins are leaves have small spines.

**VARIEGATION** = leaves are typically all green, although the presence of yellow or white streaks means that the leaves are variegated.

**NEEDLES** = many conifers have leaves that are needle-like in shape.

**TENDRILS** = these are thin, coiling structures that aid vines in their climbing. Often, tendrils are modified leaves or parts of leaves.

**CARNIVOROUS (TRAPPING) LEAF** = Where the blade or some other portion of the leaf acts to trap unsuspecting insects (sometimes small vertebrates) for later digestion (e.g., Venus fly trap, pitcher plants, sundews).

CLONING LEAF MARGINS = a few plants can reproduce asexually by producing clones of themselves on their leaf margins. Horticultural botanists may exploit this phenomenon for vegetative propagation.

YOUR TASK: Record the plants listed at this station, and describe which of the above modifications of leaves are present. Make drawings for your own study.

Start with *Agave*

1. Agave (century plant; tequilla plant)

*Describe all of the modificaitons present.*

*Agave also has something else peculiar about its leaves, what are the whitish impressions in the undersurfaces of the leaves from?*

2.

3....



### **C. Modified Stems**

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Stems are, in certain species, modified during development and evolution for functions other than support (of the leaves) and conduction of water and sugars between leaf and root.

TUBER = A swollen, typically underground stem modified for carbohydrate (starch) storage.

THORN = a pointy whole lateral stem branch that does not form leaves.

RHIZOME = an underground, horizontal stem; often a means of vegetative (asexual) reproduction.

STOLON or RUNNER = an above ground, horizontal stem; often a means of vegetative (asexual) reproduction.

CLADOPHYLL = a stem that is flatted to look like and/or function like a leaf.

HOLLOW INTERNODES = many grass relatives have a hollow pith (i.e., where you expect parenchyma to be, there is nothing but air).

Go through the plants set up and apply terms as appropriate. Record answers below.

## **D. Modified Shoots**

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Examples of whole shoots that are modified include FLOWERS, BULBS, and CORMS.

FLOWER = a determinate shoot with modified leaves, some of which bear sporangia.

BULB = usually a subterranean shoot with a very short stem and tightly packed succulent leaves. The bulk of the mass of bulbs consists of fleshy leaves, rather than stem.

CORM = a subterranean shoot consisting of a short, but fat, swollen stem and dry and papery or membranous leaves. The bulk of the mass in corms is stem, not leaf.

SHORT SHOOTS = short, usually lateral or axillary side-shoots, that are much-shortened relative normal shoot, yet are not quite BULBS or CORMS. Many conifers have them, and some angiosperms.

Naturally, any shoot whose stem is a tuber, rhizome, or stem may also be considered a “modified shoot”.

Go through the plants set up and apply terms as appropriate. Record answers below.

## E. Interesting Roots

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Roots may be variously modified for storage, solely anchorage, and even photosynthesis!

**STORAGE ROOT** = swollen roots or parts of roots specialized for storage (e.g., starch).

**PROP ROOT** = some plants such as corn, some palms, and mangrove trees have roots which serve to prop and support the stem like flying buttresses do on some buildings.

**ADVENTITIOUS ROOT** = a root borne lateral from stem tissue! Roots are usually borne as branches from the original primary root. These allow stem cuttings to root, thereby allowing vegetative propagation.

**AERIAL ROOT** = adventitious roots that borne from aerial parts of the stem (i.e., those parts not in contact with the soil. Many vines including the woody vine poison-ivy produce aerial roots for anchorage to some substrate such as a tree. The aerial roots of many EPIPHYTIC or vining orchids may also be photosynthetic.

**TAP ROOT** = the tap root is not necessarily unusual (most dicot plants have one), but sometimes, particularly in certain edible agricultural species, the tap root can be very large and conspicuous.

**PNEUMATOPHORE** = these enable plants to breathe air in habitats that have waterlogged soil. The roots may grown down from the stem, or up from typical roots. The surface of these roots are covered with lenticels which take up air into spongy tissue which in turn uses osmotic pathways to spread the needed oxygen throughout the plant as needed.

Go through the plants set up and apply terms as appropriate. Record answers below.





## **F. Succulence**

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Various organs or combinations thereof may become SUCCULENT and function (in part) in water storage. This often leads to interesting shapes and sizes of the succulent organs.

Go through the plants at this station, list them below and describe the organ(s) that are succulent.

Start with *Aloe*. Go further by taking a thin cross-section of the succulent organ, stain with toluidine blue, and make a wet-mount. View with microscope. Draw what you see. Is the organ one big bag of water or is the succulent region more of a tissue comprised of cells.

## **G. Armed Plants**

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Plants can be armed with spines, thorns, or prickles which serve any of a variety of functions. The plants at this station are tough to interpret, but try your best.

SPINE = modified from a leaf.

Do cacti have spines? Yes, they do, but this is difficult to interpret. In this case, the spines are derived from modified leaves of the short axillary bud (the bud area is called an "areole" in cacti). In a normal non-cactus plant, axillary buds have small primordial (immature) leaves, called bud scales if they are hardened and the bud is dormant; in cacti, such leaves are elongated and hardened by sclerenchyma into spines.

STIPULAR SPINE = sometimes the stipules (those usually pair appendages at the base of a leaf--sometimes appearing on the stem at the node but technically still considered a part of the leaf by botanists) are modified into spines.

THORN = modified from a stem. Since it is stem, thorns can also branch and may also have bark or growth rings when seen in cross section.

PRICKLES = modified epidermal protrusions (from the epidermises of leaves, stems, or what have you). Positionally, if these are not where you'd expect to find a leaf, stem, branch, or axillary bud, then chances are they're prickles.

With the armed plants on display, list them below and describe which of the above terms apply.

## H. The Market Place Exercise

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Exactly what part of the plant do you eat if you eat each of the vegetable products on display in the laboratory?

Can you apply botanical terms to describe the plant parts (e.g., leaf arrangement or phyllotaxy, leaf venation, etc.)?

Use your understanding of plant architecture and terminology to fill in the tables on the following pages.

### H1. Common and / or Scientific Name?

Root System?	Shoot System?	<input type="checkbox"/> Seedling <input type="checkbox"/> Embryo, and/or <input type="checkbox"/> Seed?
<input type="checkbox"/> Tap root or fibrous sysetm? <input type="checkbox"/> Lateral roots present? <input type="checkbox"/> Evidence for their endogenous origin? <input type="checkbox"/> Evidence for secondary growth/thickening of root? <input type="checkbox"/> Are the roots tuberous? <input type="checkbox"/> Adventitious roots? <input type="checkbox"/> Other?	<input type="checkbox"/> Leaves present <input type="checkbox"/> Scales <input type="checkbox"/> Succulent leaves <input type="checkbox"/> Tubular or sheathing leaf base <input type="checkbox"/> Leaves sessile <input type="checkbox"/> Leaves petiolate <input type="checkbox"/> Pinnate venation <input type="checkbox"/> Palmate venation <input type="checkbox"/> Alternate phyllotaxy <input type="checkbox"/> opposite phyllotaxy <input type="checkbox"/> whorled phyllotaxy <input type="checkbox"/> Stem present <input type="checkbox"/> Succulent stem <input type="checkbox"/> Tuber <input type="checkbox"/> Stem branching <input type="checkbox"/> Nodes present <input type="checkbox"/> Internodes present <input type="checkbox"/> Axillary buds <input type="checkbox"/> Sclerenchyma present in <u>leaves</u> or <u>stem</u> ? (circle appropriate) <input type="checkbox"/> Collenchyma present in <u>leaves</u> or <u>stem</u> ? (circle appropriate) <input type="checkbox"/> Other?	<input type="checkbox"/> Cotyledons? Number? _____ <input type="checkbox"/> Epicotyl <input type="checkbox"/> Hypocotyl <input type="checkbox"/> Plumule <input type="checkbox"/> Radicle <input type="checkbox"/> Seed coat <input type="checkbox"/> Endosperm <input type="checkbox"/> Sclerenchyma <input type="checkbox"/> Root hairs <input type="checkbox"/> First true (non-cotyledonous leaves) <input type="checkbox"/> Other?

## H2. Common and / or Scientific Name?

Root System?	Shoot System?	<input type="checkbox"/> Seedling <input type="checkbox"/> Embryo, and/or <input type="checkbox"/> Seed?
<input type="checkbox"/> Tap root or fibrous sysetm? <input type="checkbox"/> Lateral roots present? <input type="checkbox"/> Evidence for their endogenous origin? <input type="checkbox"/> Evidence for secondary growth/thickening of root? <input type="checkbox"/> Are the roots tuberous? <input type="checkbox"/> Adventitious roots? <input type="checkbox"/> Other?	<input type="checkbox"/> Leaves present <input type="checkbox"/> Scales <input type="checkbox"/> Succulent leaves <input type="checkbox"/> Tubular or sheathing leaf base <input type="checkbox"/> Leaves sessile <input type="checkbox"/> Leaves petiolate <input type="checkbox"/> Pinnate venation <input type="checkbox"/> Palmate venation <input type="checkbox"/> Alternate phyllotaxy <input type="checkbox"/> opposite phyllotaxy <input type="checkbox"/> whorled phyllotaxy <input type="checkbox"/> Stem present <input type="checkbox"/> Succulent stem <input type="checkbox"/> Tuber <input type="checkbox"/> Stem branching <input type="checkbox"/> Nodes present <input type="checkbox"/> Internodes present <input type="checkbox"/> Axillary buds <input type="checkbox"/> Sclerenchyma present in <u>leaves</u> or <u>stem</u> ? (circle appropriate) <input type="checkbox"/> Collenchyma present in <u>leaves</u> or <u>stem</u> ? (circle appropriate) <input type="checkbox"/> Other?	<input type="checkbox"/> Cotyledons? Number? _____ <input type="checkbox"/> Epicotyl <input type="checkbox"/> Hypocotyl <input type="checkbox"/> Plumule <input type="checkbox"/> Radicle <input type="checkbox"/> Seed coat <input type="checkbox"/> Endosperm <input type="checkbox"/> Sclerenchyma <input type="checkbox"/> Root hairs <input type="checkbox"/> First true (non-cotyledonous leaves) <input type="checkbox"/> Other?

## H3. Common and / or Scientific Name?

Root System?	Shoot System?	<input type="checkbox"/> Seedling <input type="checkbox"/> Embryo, and/or <input type="checkbox"/> Seed?
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#### H4. Common and / or Scientific Name?

Root System?	Shoot System?	<input type="checkbox"/> Seedling <input type="checkbox"/> Embryo, and/or <input type="checkbox"/> Seed?
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Root System?	Shoot System?	<input type="checkbox"/> Seedling <input type="checkbox"/> Embryo, and/or <input type="checkbox"/> Seed?
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Root System?	Shoot System?	<input type="checkbox"/> Seedling <input type="checkbox"/> Embryo, and/or <input type="checkbox"/> Seed?
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### H10. Common and / or Scientific Name?

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### H11. Common and / or Scientific Name?

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H12. Common and / or Scientific Name?

Root System?	Shoot System?	<input type="checkbox"/> Seedling <input type="checkbox"/> Embryo, and/or <input type="checkbox"/> Seed?
<input type="checkbox"/> Tap root or fibrous sysetm? <input type="checkbox"/> Lateral roots present? <input type="checkbox"/> Evidence for their endogenous origin? <input type="checkbox"/> Evidence for secondary growth/thickening of root? <input type="checkbox"/> Are the roots tuberous? <input type="checkbox"/> Adventitious roots? <input type="checkbox"/> Other?	<input type="checkbox"/> Leaves present <input type="checkbox"/> Scales <input type="checkbox"/> Succulent leaves <input type="checkbox"/> Tubular or sheathing leaf base <input type="checkbox"/> Leaves sessile <input type="checkbox"/> Leaves petiolate <input type="checkbox"/> Pinnate venation <input type="checkbox"/> Palmate venation <input type="checkbox"/> Alternate phyllotaxy <input type="checkbox"/> opposite phyllotaxy <input type="checkbox"/> whorled phyllotaxy <input type="checkbox"/> Stem present <input type="checkbox"/> Succulent stem <input type="checkbox"/> Tuber <input type="checkbox"/> Stem branching <input type="checkbox"/> Nodes present <input type="checkbox"/> Internodes present <input type="checkbox"/> Axillary buds <input type="checkbox"/> Sclerenchyma present in <u>leaves</u> or <u>stem</u> ? (circle appropriate) <input type="checkbox"/> Collenchyma present in <u>leaves</u> or <u>stem</u> ? (circle appropriate) <input type="checkbox"/> Other?	<input type="checkbox"/> Cotyledons? Number? _____ <input type="checkbox"/> Epicotyl <input type="checkbox"/> Hypocotyl <input type="checkbox"/> Plumule <input type="checkbox"/> Radicle <input type="checkbox"/> Seed coat <input type="checkbox"/> Endosperm <input type="checkbox"/> Sclerenchyma <input type="checkbox"/> Root hairs <input type="checkbox"/> First true (non-cotyledonous leaves) <input type="checkbox"/> Other?

Space for additional items or drawings from the market basket (using the format above):

## **I. Propagation of modified stems, roots, and leaves: Rhizomes, tubers, areoles, and even leaves!**

There are some species in the market place section (section H) for which we had a lot of material. This is b/c they are easily propagated vegetatively (exploiting the plants' capability for asexual reproduction).

1. Find these vegetables,
2. think about how to cut them up (hint: make sure there is always a node and either shoot apical meristem or axillary bud present on a division segment), and
3. then pot some of these up in the greenhouse (INSTRUCTOR OPTION: LIMIT of one from each species for each group).
4. Label it, water it, put it in the greenhouse or back of lab beneath grow lamps to watch it grow over the rest of the semester.