**Biology 1306/1406 – Modern Concepts in Bioscience II**

**Hello and welcome to the weekly resources for BIO-1306/1406 - Biology 2**

**This week is Week 8 of class, and typically in this week of the semester, your professors are covering the topics below.** If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout the semester.

We also invite you **to look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester.**

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel, or any tutoring services we offer, please visit our website www.baylor.edu/tutoring or call our drop in center during open business hours (M-Th 9am8pm on class days at 254-710-4135).

# Topic of the Week:

This week in Biology 1306, we will be covering vascular plant structure, growth and development, and response to stimuli.
Campbell Chapters 35, 39, and 44

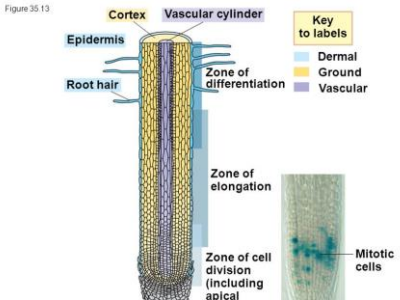
## Vascular Plant Structure, Growth, and Development – Campbell Ch. 35

**Classifying Plant Organs**:
**Roots:** plant organs which anchor vascular plants in the soil. These have a *high surface area* for absorbing water and minerals
**Taproots**- have a long core root with *lateral roots* branching.
**Fibrous roots**- have a thick tangle of roots under the soil.
**Shoots:** Stems and leaves
**Stems:** support growth and transport
**Leaves:** photosynthesis/gas exchange, modulate heat control, and energy (sugar) storage

**Types of Tissues of Plant Organs**:
**Vascular Tissue:** xylem and phloem
**Dermal Tissue:** tissues which protect the plant from external environment and prevent desiccation
**Epidermis** (non-woody plants) a single layer of tissue that provides a boundary with the environment
**Ground Tissue:** tissue *not* categorized as dermal or vascular; may be internal to the vasculature (**pith**) or external to the vasculature (**cortex**).
**Cuticle:** a thin, waxy layer over which covers the upper epidermis of leaves
**Periderm** (woody plants)**:** tissues that replace the epidermis in woody plants

**Meristems and Plant Growth**

**Determinate Growth:** growth that has specific genetic limits, such as flowers, thorns, or leaves
**Indeterminate Growth:** growth which is active throughout a



plant's life (meristematic)
**Primary Growth:** The growth that extends the roots and shoots (increases the length of section)
**Apical Meristem:** primary growth occurs in the roots and shoots.

**Zone of cell division:** houses stem cells which constantly divide
**Zone of elongation:** is where the actual lengthening happens
**Zone of differentiation:** cells *differentiate* into the 3 tissue types (**ground**, **dermal**, **vascular**).
**Shoot apical meristem**- where most primary shoot growth occurs
**Apical Dominance:** when an **axillary bud** is inhibited the nearer it is to an apical meristem; prevents the formation of lateral branches
**Secondary Growth:** Lateral growth which increases the width of the plant
**Lateral Meristem:** secondary growth occurs via lateral divisions of the **vascular cambium** (adds secondary xylem and phloem) and the **cork cambium** (turns waxy epidermis and periderm → bark)

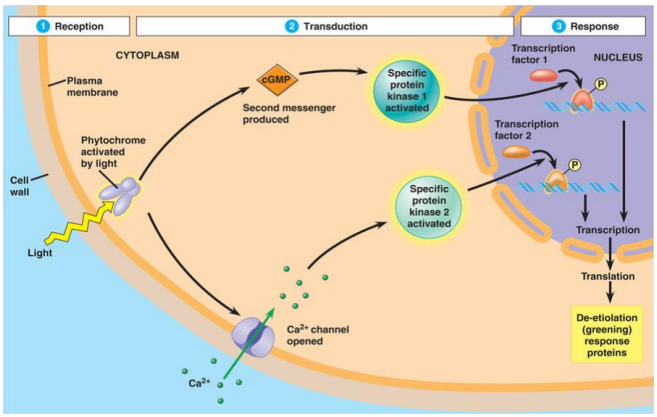
Check out this video to learn more about vascular plants:
https://www.youtube.com/watch?v=h9oDTMXM7M8

## Plant Responses to Internal and External Signals- Campbell Ch. 39

**Hormones:** Molecules produced in low quantities and transported to another site to produce a response

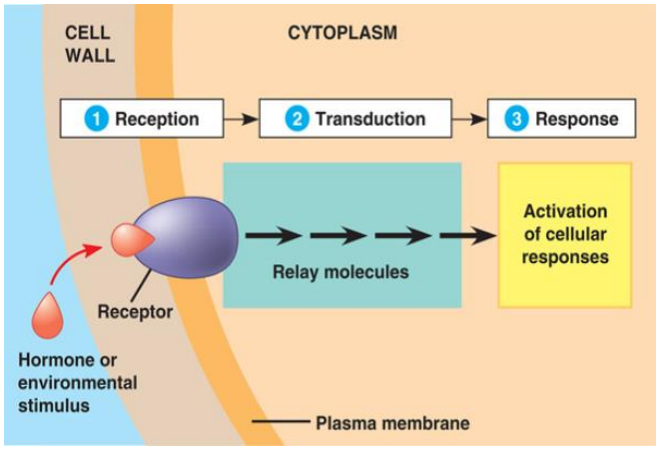
### Signal Transduction in Plant Cells:

**Transduction:** the transformation of a physical stimulus from the environment into a cellular response
**Etiolation:** morphological adaptations that allow plants to grow in darkness before emerging (thin shoots; unexpanded leaves)
**De-Etiolation:** aka. greening: shoot and root elongation; development of ***chlorophyll-bearing*** leaves




<u>The De-Etiolation Process in Plants:</u>
**Reception:** light strikes the membrane *phytochrome* protein (little light needed to respond)
**Transduction:** two pathways emerge using a **secondary messenger** (cGMP) and $Na^+$
**Path 1:** cGMP activates a protein kinase (PK1)
**Path 2:** *phytochrome* opens a $Na^+$ channel, whose ions activate a protein kinase (PK2)
**Response:** PK1 will phosphorylate Transcription Factor 1 (TF1); PK2 will phosphorylate TF2. This leads to the transcription of genes coding for **de-etiolation** proteins.

Hormones (Table 39.1):




**Auxin:** controls stem elongation and controls ***apical dominance***
**Tropism:** the growth of a shoot toward or away from a stimulus (*phototropism*: specific to light)
**Cytokinins:** regulate division in roots and shoots; promote lateral grown; regulate solute movement
**Gibberellins:** sex differentiation, pollen and pollen tube development and sperm elongation
**Abscisic Acid (ABA):** inhibits growth
**Ethylene:** promotes ripening of fruit, lateral branching of shoots and pineapple flowering
**Brassinosteroids:** promote division in shoots; low concentration increase root growth while high concentrations reduce growth
**Jasmonates:** regulate fruit ripening, floral development/pollen production; responds to pathogens or herbivores
**Strigolactones:** control seed germination and apical dominance; recruits *mycorrhizal fungi*

**Watch this video on plant hormones: https://www.youtube.com/watch?v=HdwIcIkSoBY**

***A plant's ability to respond to and absorb light is crucial for its survival.***

**Photomorphogenesis:** key events in plant growth and development that are dependent on light
**Two Major Classes of Light Receptors:**

**Blue-Light Photoreceptors**-initiates phototropism, light-induced opening of stomata, and the light-induced slowing of hypocotyl elongation that occurs when a seedling breaks ground

**Phytochromes-** absorb mostly red light; regulate seed germination and shade avoidance

-In most cases, the light absorbing portion of the phytochromes are **photoreversible.**

-The interconversion between the phytochromes red-absorbing form ($P_r$) and the far-red absorbing form ($P_{fr}$) is what controls and triggers various events in the plant

-Phytochromes also assists in maintaining the plant's measure of time

**Some More Definitions:**

**Circadian Rhythms:** sleep movements and physiological processes that occur with a consistent frequency of about **24 hours** that are not directly influences by environmental variables

-Interactions between the amount of light phytochromes absorb and the natural biological clock of the plant allows the plant to measure the days and seasons.

**Photoperiodism:** physiological response to specific night or day lengths

**Short-day plants/ long-night plants:** requires a light period shorter than a minimum critical length to flower

**Long-day plants/ short-night plants:** flower only when the light period is longer than a certain maximum number of hours

**Day-neutral plants:** unaffected by photoperiod

**Gravitropism:** plants' response to gravity; roots display positive gravitropism (with gravity) and shoots exhibit negative gravitropism (away from gravity)

**Statoliths:** components that settle to the lower portion of the cell due to gravity; helps plant detect gravity's direction

**Thigmomorphogenesis:** changes in physical form that result from mechanical perturbation (wind, touch, any mechanical stress)

**Thigmotropism:** change in directional growth in response to touch by another organism

## How do plants respond to Abiotic Stressors?

**Drought:** plants will reduce rate of transpiration, stomata will close, synthesis of abscisic acid will increase and be released, photosynthesis will decrease

**Flooding:** leads to oxygen deprivation which will in response, stimulate production of ethylene, causing root cortex cells to die to provide "snorkels" for air to get in

**Salt Stress:** causes a water deficit by lowering the water potential gradient, reducing water uptake

**Heat Stress:** can denature plant enzymes; stomata will close to conserve water but this prevents evaporative cooling from occurring; in response, plant will synthesize heat-shock proteins to protect other proteins from denaturation

**Cold Stress:** membranes become less fluid, and the lipids form crystalline structures

## How do plants defend against pathogens and herbivores:

The **epidermis** and the **periderm** of the plant body initially provide a physical barrier against infection

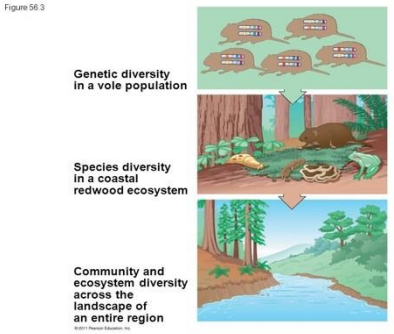
**Second line of defense is 2 immune responses:**

**PAMP-triggered immunity**- if the plant recognizes molecular sequences that are specific to certain pathogens, a chain signaling response begins and produces **phytoalexins** (antimicrobial chemicals)

**Effector-triggered immunity**- both a local and a general defense against pathogens; restricts the spread of a pathogen by impairing the pathogen's cell wall integrity, metabolism or reproduction; produces salicylic acid that activates a signal transduction pathway

**Herbivory:** animals eating plants; plants have several defenses:

- **Molecular-Level Defense:** chemical compounds to deter attackers
- **Cellular-Level Defense:** vacuoles can be used to store chemicals to deter attackers; **raphide crystals** can also release an irritant into the attackers' soft tissues
- **Tissue-Level Defense:** hardened sclerenchyma makes chewing difficult
- **Organ-Level Defense:** organ shapes can either be unappealing or can be difficult/painful to ingest
- **Organism- Level Defense:** physiological changes due to mechanical damage
- **Population-Level Defense:** coordinated behavior can ward off predators



**Community-Level Defense:** species can recruit/ assist another species that is a predator of the herbivore and in return receive protection

## Osmoregulation and Excretion: Campbell Chapter 44

**Osmoregulation** is achieved by actively pumping solute in and out of cells to move water passively. There are two ways to maintain water balance: **Osmoconformance** and **Osmoregulation.** Most invertebrates are osmoconformers and all osmoconformers are marine animals. Here are a few definitions to be familiar with:

**Osmoregulation:** active transport of solutes to passively move water
**Osmocomformer:** does not transport solute, takes on the conditions of the external environment (isosmotic with its surroundings) **ALL OSMOCONFORMERS ARE MARINE ANIMALS**
**Osmoregulator:** will actively move solute to create a new ideal environment for the organism
**Stenohaline:** organism that cannot tolerate changes in external osmolarity
**Euryhaline:** organism that can survive large changes in osmolarity (ex. Salmon)

Animals face different challenges related to osmolarity and therefore regulate differently:
**Marine animals'** main issue is water loss due to higher solute concentration in their environment, so they excrete **urine with a high concentration of salt** and very little water. **Land Animals** face the same issue, instead worrying dehydration. They **convert NH3 to urea** prior to excretion as a way to conserve water. **Freshwater Animals** face the opposite problem. Due to the higher concentration of salts in their bodies, as compared to their outside environments, they are worried about water gain. Thus, they take in salt through their gills and **excrete large amounts of very dilute urine**.

THE MAIN PURPOSE OF EXCRETION IS TO ELIMINATE NITROGEN WASTE

**Fish** eliminate nitrogen in the form of **Ammonia** because it is highly soluble in water, but it is also highly toxic. **Mammals, amphibians, sharks and some fish** eliminate **Urea**. Though it is not as soluble as ammonia, it helps prevent water loss in terrestrial animals. **Birds, insects, and reptiles excrete Uric Acid.** Though it requires much more energy to process, it is much less toxic and thus will not poison an organism while it is still growing inside an egg. **The form of nitrogen waste excreted will always match its function!!!**

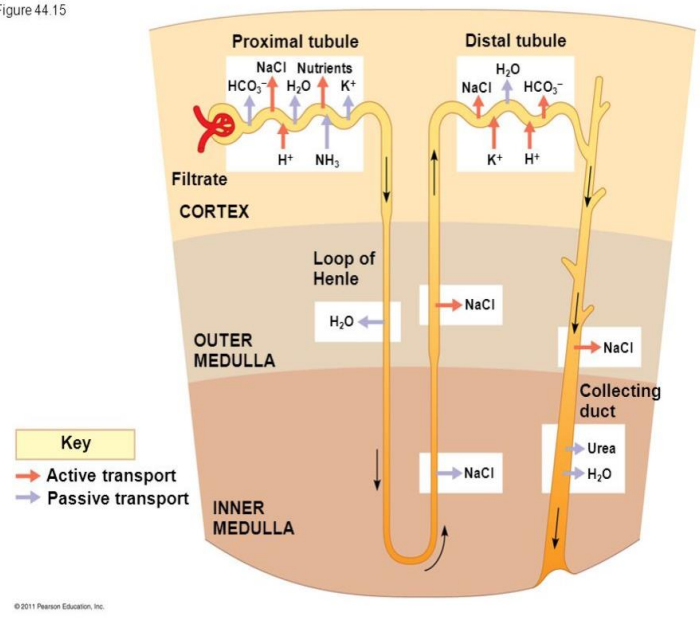
**Diverse Excretory Systems are Variations on a tubular theme:**
**Protonephridia-** seen in flatworms which lack a body cavity. Cellular units called **flame bulbs** cap the ends of the protonephridia and each bulb has tubule projections covered in cilia which beat water and solutes from the interstitial fluid before excreting it (purely osmoregulatory)
**Metanephridia-** seen in earthworms where each segment gathers its own wastes and excretes it through holes in the skin
**Malpighian Tubules-** seen in insects and arthropods; Out pockets dump nitrogenous wastes into the digestive system to be excreted. Some of the salts are reabsorbed in the rectum

## Nephrons are the functional unit of the Kidney.

There are 5 steps in the nephron process. It is important to remember that we discuss "in" and "out" in relation to the filtrate, not the body.

1. Blood is filtered and filtrate is pushed out of the **Glomerulus** and into **Bowman's Capsule**
2. In the **proximal tubule**, H+ is actively transported in, NaCl and nutrients actively out, NH3 passively in, and water, K+, and HCO3 out
3. Next the filtrate enters the **Loop of Henle,** where 90% of reabsorption happens
   a. **Descending:** water is transported out passively
   b. **Ascending:** the vessel is impermeable to water and NaCl is actively transported out to re-establish the concentration gradient in the kidney
4. Then the K+ and H+ are actively transported in, NaCl and HCO3 actively out, and water passively out at the **Distal Tubule**

Figure 44.15




5. Finally, the filtrate reaches the **Collecting Duct**, the most important position for finalizing the filtrate. The collecting duct can be regulated by a couple of hormones
   a. **Anti-Diuretic Hormone (ADH)-** makes the collecting duct permeable to water, causing water to be reabsorbed into the body (OUT of filtrate)
   **b. RAAS-** acts similarly, increasing the Collecting Duct's permeability to water thus increasing blood volume

## CHECK YOUR LEARNING

1. What is the main purpose of excretion?
2. Where does primary growth occur in plants?
3. What is Gravitropism?

## THINGS YOU MAY STRUGGLE WITH

1. Vocabulary! These chapters are all about memorization. Make sure that you can differentiate between the similar concepts presented by your professor.
2. Plant Hormones. Check out the video linked in that section!
3. The structure and function of a nephron. Draw! Draw! Draw! The more you draw the structure, the more familiar it will be.

## Study Tips:

*** Review all vocabulary in each chapter and make sure you understand what the terms mean***

**That's all folks.**

**If you have any questions, feel free to reach out to the tutoring center or use the link at the top of the resource to make an appointment.**

Answers:

1. To excrete nitrogen waste.
2. At the apical meristem
3. A plant's response to gravity! Roots have positive gravitropism and shoots have negative gravitropism.