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 11 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 Plant Responses to Signals

Campbell Chapters 39, 40, 54, and 55.

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

The De-Etiolation Process in Plants:

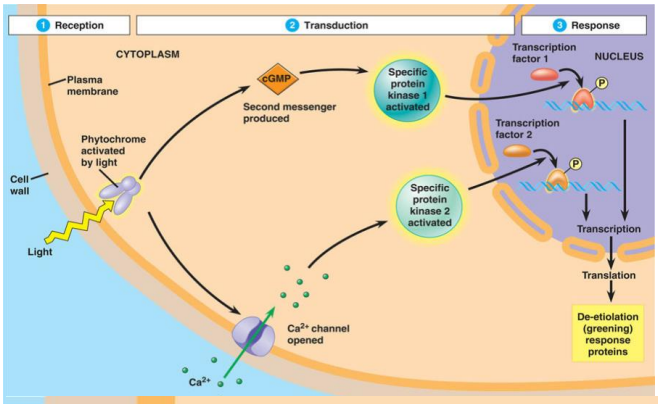
Reception: light strikes the membrane phytochrome protein (little light needed to respond)

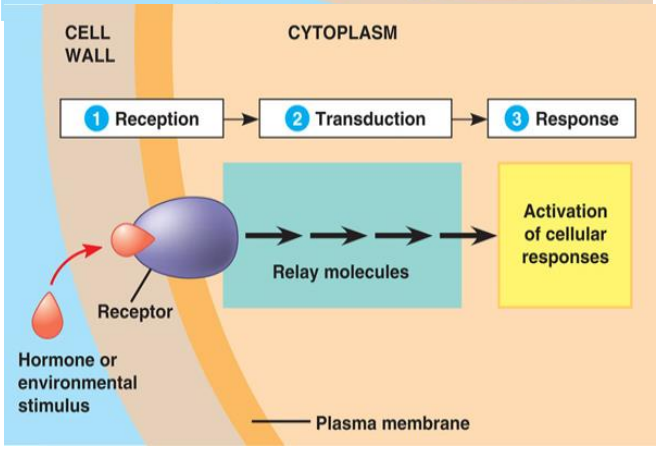
Transduction: two pathways emerge using a **secondary messenger** (cGMP) and Na^+

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

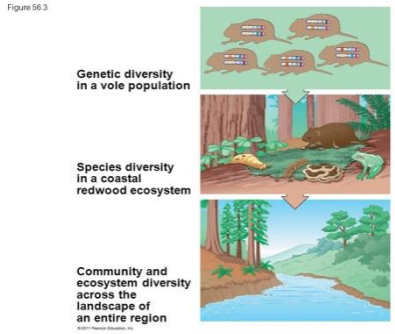
Second line of defense is 2 immune responses:

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



Highlight 1: Basic Principles of Animal Form and Function: Campbell chapter 40

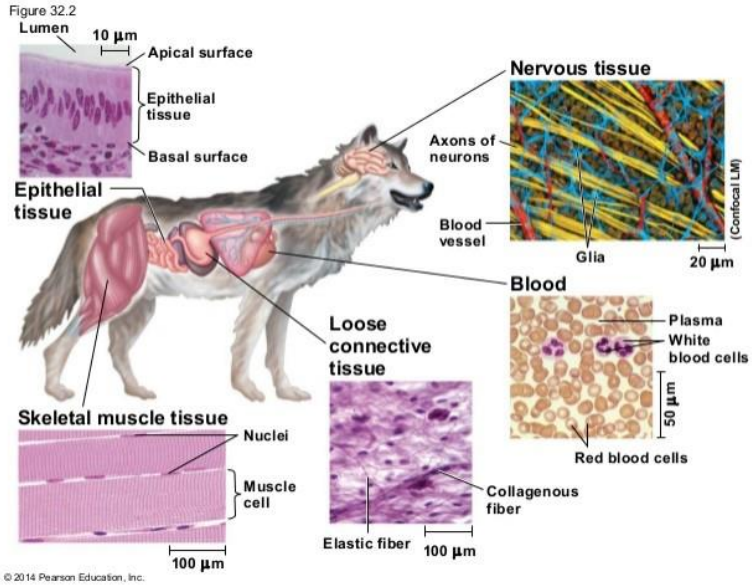
This chapter is very definition heavy. One thing that is important to remember as we learn different types of cells is the order of different levels of body plan organization. In order of increasing complexity, they are **cells, tissues, organs, organ systems and bodies.** By increasing complexity, organisms are able to maximize their **Surface Area to Volume** ratios. This is

important because it enables organisms to exchange nutrients, water and other materials with their environment.

Within these complex organisms are different tissues:

Epithelial Tissue- lines organs, covers the body and is held together by tight junctions

- Polarized: when something is found on one side and not the other, meaning that there is an apical and basal side
- Functions as a barrier
- Avascular (no blood vessels)
- Stratified squamous, cuboidal, simple columnar, simple squamous, pseudostratified



Connective tissue- lies underneath epithelial tissue, has blood vessels (vascular)

- Blood, cartilage, adipose (fat), bone, fibrous (tendons and ligaments), and loose (found in skin)
- Collagenous fibers: provide strength and flexibility
- Reticular fibers: join connective tissue to adjacent tissue
- Elastic Fibers: make tissue elastic

Muscle Tissue- all muscles cells consist of filaments containing the proteins **actin** and **myosin** which enable the muscles to contract

- Skeletal muscle, smooth muscle, and cardiac muscle

Nervous Tissue- makes up the Central Nervous System and the Peripheral Nervous System

- Neurons and Glia (the support cells which make up myelin)

Animals must also balance heat gain and heat loss. Different animals do this in different ways, but for the purposes of this class, we will focus on specific terms including:

Poikilotherm: organism which has a varying body temperature

Homeotherm: organism which has a constant body temperature

Exotherm: organism which gains their heat from external sources

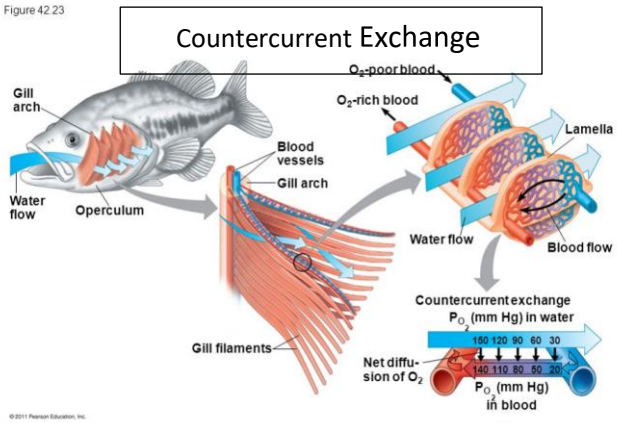
Endotherm: organism which is warmed by heat generated through metabolism

All endotherms are homeothermic, but some exotherms can be as well, depending on their external environments.

Insulation: prohibits heat loss, ex. Blubber or fur

Circulatory Adaptations: changing the width of blood vessels to conserve heat through Vasoconstriction and Vasodilation

Countercurrent Exchange: arterial and venous blood flow close to each other in two different directions, allowing for thermoregulation, gas exchange, and fluid exchange.



Highlight 2: Community Ecology – Campbell Chapter 54

This chapter focuses on interactions within a **Biological Community**, or a group of populations of different species living in close enough proximity to interact. We call these interactions **Interspecific Interactions**.

There are 5 types of interspecific (between species) interactions:

Competition- hurts both organisms
Exploitation- helps one organism and harms the other
Parasitism- parasite derives its nourishment from another organism, the host, which is harmed in the process
Herbivory- ***helps the animal, hurts the plant***; animal eating a plant
Mutualism- ***both species benefit***; the benefits to each partner must exceed the costs
Commensalism- ***helps one organism and does not affect the other***; turns into mutualism
Symbiosis- ***helps both organisms***, direct intimate contact between species
Facilitation- ***has a positive effect without being in direct contac***t with another organism; can either help both partners, or help one and not affect the other

Some Terms to understand:

Competitive Exclusion- the theory that even a slight reproductive advantage will eventually lead to local elimination of the inferior competition;
https://www.youtube.com/watch?v=Ddq5tXVZ2HA
Ecological Niche- the organism's ecological role or how they fit into the ecosystem; the specific set of biotic and abiotic resources and organism uses in its environment. Two species cannot coexist forever in the same community if their niches are identical. They can only coexist if a significant difference in their niches occurs over time
Resource Partitioning- the differentiation of niches that enable similar species to coexist in a community, ex. Lizards living in different levels of a canopy
Fundamental Niche- niche potentially occupied by a species
Realized Niche- portion of the fundamental niche that a species occupies
Character Displacement- the tendency of characteristics to diverge more between sympatric populations than between allopatric populations of two species
Allopatric populations- similar resources and niches with geographic isolation
Sympatric populations- differences in body structure and resources they use; geographically overlapping
Predation- interaction between species where ***one species eats the other***

- **Predator-** acute senses, claws, fangs, poison to hunt and catch prey
- **Prey-** behavioral defenses (hiding, fleeing, forming herds)
- **Aposematic Coloring-** coloring that warns the prey has chemical defenses (poison dart frog, skunk)
- **Cryptic Coloration-** camouflage
- **Batesian Mimicry-** when a harmless species mimics a harmful species in behavior or appearance
- **Mullerian Mimicry-** harmful species that resemble each other (ex. Bee and yellow jacket)

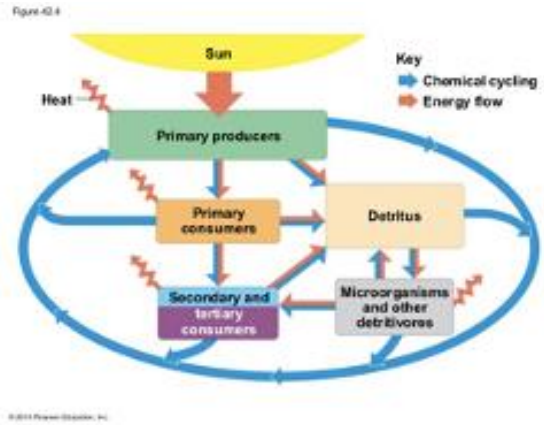
Endoparasites- live in the body

Ectoparasites- feed on the external surface of the body (tick, larva)

Obligate mutualism- host needs the other to survive

Facultative mutualism- both host and parasite live independently

Highlight 3: Ecosystems and Restoration Ecology – Campbell Chapter 55



Ecosystems consist of all of the biotic and abiotic factors in an area. Within an ecosystem, there is a **flow of energy** from the sun, to the heat that is eventually lost to the environment. Throughout this process, detailed below, energy is conserved. Similarly, the chemical elements that enter and leave an ecosystem are conserved according to the law of conservation of mass. How much energy is available at each trophic level is determined by:

Net primary production: the energy accumulated in plant biomass

Production efficiency: the efficiency of turning chemical energy into biomass at each level of the food chain; how effectively energy level is maintained

Trophic Efficiency: the percentage of energy that is transferred from one trophic level to the next in a food chain; this is usually 10%

- For example, when a lion eats a gazelle, the lion is only going to get 10% of the energy held in the gazelle's organic matter

Finally, we will briefly touch on the concept of ecological succession:

Ecological Succession: a sequence of changes in community composition following a disturbance. Succession can be PRIMARY or SECONDARY.

Primary Succession: this occurs when no soil or any other substrate exists, and therefore it must be created. Examples are volcanic islands and moraines left by glaciers melting

Secondary Succession: this occurs when soil or any other substrate exists, but it cannot support life (no nutrients). Examples include agricultural fields that have been exploited and abandoned, and areas that have burned.

CHECK YOUR LEARNING

1. What is Gravitropism?
2. What is a poikilotherm and how does that relate to a homeotherm?
3. What is the main difference between primary and secondary succession?

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. Types of succession: Starting from soil is secondary, if there is no soil, it's primary, and soil must be created.

3. The amount of content in these chapters. Take a deep breath and study a little bit each day. You'll be thankful when the test rolls around!

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. A plant's response to gravity! Roots have positive gravitropism and shoots have negative gravitropism.
2. Poikilotherms have varying body temperatures and Homeotherms have constant body temperatures.
3. Primary succession occurs when there is no soil. Secondary succession occurs when soil or some other substrate is present.