**Analyzing how plants detect and defend themselves against herbivores & environmental stresses (Ch 39)**

*You must know:*

* The three steps to a signal transduction pathway
* The role of auxins in plants
* The survival benefits of phototropism and photoperiodism use changes in environment to modify plant growth and behaviour
* How plants respond to attacks by herbivores and pathogens



**Signal transduction pathway**

**Reception**: Receptors undergo changes in shape due to an environmental stimulus.  Most are in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ some are in the cytoplasm.

*Phytochrome*- an example of a receptor in the cytoplasm.  It’s a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_protein. It is involved with a plants ability to grow in the dark, referred to as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Transduction**: Amplification of signal through a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_pathway. Allows small signal to produce large cellular response. Uses protein kinases (phosphorylation cascade) and second messengers (Ca2+ and cAMP)

Light causes phytochrome to change shape.  One activated phytochrome molecule may trigger hundreds of molecules of a second messenger, each of which may lead to the activation of hundreds of enzymes.

**Response**: Two ways response is accomplished:

1. Transcriptional Modification: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_mRNA production (turning genes on/off)
2. Post-Translational Modification: Activates existing enzyme molecules

**Plant Hormones**

**Hormones**: chemical messengers that coordinate the different parts of a multicellular organism

**Tropism**: Plant growth response toward or away from a stimulus

[Phototropism](http://39_05phototropism_sv.mpg)

[Gravitropism](http://39_24gravitropism_sv.mpg)

**Examples of hormones**

Auxins – stimulate elongation of cells within young developing shoots
Cytokinins – stimulate cell division (roots)
Gibberellins – stimulate stem elongation, pollen, fruit, seed development
Abscisic acid – promotes stomatal closure during drought stress
Ethylene (gas!) – fruit ripening, leaf abscission

**Phototropism** - Mechanism



A plant’s response to light is critical for its success

2 classes of light receptors

Phytochromes & Blue-light photoreceptors

Plants can detect the presence of light as well as the direction, intensity and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Biological clocks & circadian rhythms**

Photoperiodism – physiological response to a photoperiod (relative lengths of day and night)

Example: Flowering

Circadian rhythms – physiological cycles that have a frequency of about 24 hours

Gravitropism, response to gravity, roots display positive gravitropism and shoots exhibit negative gravitropism.

Auxin plans a key role in this.

**Responses to Mechanical Stimuli**

Herbivore Defense

Environmental Stress