PLANT STRESS PHYSIOLOGY (H675 3 credits)

Location and time:	Lecture: 203 Shepardson, 11:00-12:15 Tues, Thurs.
Instructor:	Dr. Cecil Stushnoff, 113B Shepardson, 491-7110 Stushnof@lamar.colostate.edu
Asst. instructor:	Oktay Kulen

OUTLINE OF TOPICS

Aug. 27-29	**Orientation and review of topics to be covered** $ Developing a research philosophy $ Creative and scholarly endeavors
Sept. 3-5	$ Impact of environmental stress on plant growth and crop production $ Review of concepts used to understand temperature effects on plant growth and development
	High Temperature Stress
Sept. 10-12	$ Physiological mechanisms $ Plant membranes $ Carbon balance
Sept. 17-19	$ Biochemical mechanisms $ Heat shock proteins
Sept. 24	$ Global warming
Sept. 26	1 st. Test
	Low Temperature Stress
Oct. 1-3	**Chilling injury** $ Membrane dysfunction, transitions and leakage
Oct. 8-10	**Physiological responses related to induction of stress tolerance** $ Seasonal adaptation of woody plants, dormancy and acclimation
Oct. 15-17	**Freezing of aqueous solutions and freezing processes in plant tissues** $ Ice nucleation, INA bacteria, intrinsic nucleation $ Heterogeneous and homogeneous ice nucleation

Oct. 22	**Thermodynamic characterization of freezing events** $ Supercooling, vitrification $ Differential thermal analysis, Differential scanning calorimetry, Ultrasonic emissions
Oct. 24	**Tolerance of freeze-induced desiccation stress** $ Extracellular and intracellular freezing $ Membrane damage
Oct. 29	**Avoidance of freeze-induced desiccation stress** **$** Supercooling as an avoidance mechanism
Oct. 31	**Biochemical mechanisms** $ Induction of endogenous cryoprotectants $ Compatible osmolytes
Nov. 3	2nd. Test
Nov. 5	**Cryopreservation of plant germplasm** $ Seeds $ Vegetative tissues
Nov. 12-14	**Plant Improvement/Molecular Biology** $ Breeding for cold hardiness $ Molecular aspects
Nov. 19	**Molecular biology - in search of cold hardiness genes** **$** Cold regulated genes
Nov. 26-28	Thanksgiving break
Dec. 3-5	**Interacting mechanisms** $ Oxygen active species and free radical injury $ Air borne pollutants, radiation stress
Dec. 10-12	Presentation of grant proposals
Dec. 16-20	**Fall Finals** - 3rd. Test

Basis for Grade Determination

Two tests	50%
Written grant proposal or research project and poster	30%
Paper presentations, laboratory reports	20%

(Each paper presentation should be a 10-12 minute, concise summary of the key findings with 5 minutes for questions)

COURSE OBJECTIVES

- To gain knowledge about the impact of environmental stresses on whole plant responses, on plant physiological processes, on biochemical mechanisms and on molecular biology of environmental stresses.
- To learn about research approaches being used to study environmental stresses by examining recent publications from scientific journals.
- To become familiar with terminology used in environmental stress research.
- To examine global issues related to the environment and plant stresses.
- To learn how to interpret complex concepts from research papers and to think about how we might apply research principles to solve problems of interest.
- To encourage in-depth thinking about research in environmental stress from reading and from discussions in class.
- To integrate concepts from related science disciplines in development of research projects.
- To facilitate discussion and study of biochemical and molecular mechanisms responsible for resistance to environmental stresses and factors causing injury during stress.
- To provide an opportunity for students to sharpen written and oral communication skills associated with research.

Laboratory Exercises (Depending on class size and interest)

1. Heat Shock/thermo-tolerance: Assess visual symptoms, membrane stability, impairment of tetrazolium chloride reduction capacity and effects on % galactosidase hydrolytic enzyme activity.

2. Chilling injury: Assess membrane stability, impairment of tetrazolium chloride reduction capacity, and effects on % galactosidase hydrolytic enzyme activity.

3. Freezing test of woody plant dormant buds and xylem ray parenchyma: Learn to evaluate freeze injury based on visual symptoms, leakage test, and differential thermal analysis.

4. Evaluate freezing behavior using differential scanning calorimetry.

5. Determine soluble sugar content of cold hardened dormant woody plant tissues. Lyophilize, grind, screen and prepare samples for gas chromatography for determination of soluble sugars.