Biology 212 Lab, Fall 2014

Principles of Biology II Laboratory

Course Learning Objectives: By the end of this course students should understand some fundamental principals in introductory biology through investigative learning. Specific outcomes include:

1. Ability to collect quantitative data and analyze the data using simple statistical techniques.
2. Ability to design and conduct research projects in discovery and hypothesis testing.
3. Understand components, process and significance of photosynthesis.
4. Ability to describe the plant cells, tissues and organs and related them to function.
5. Understand the structures and functions of major body systems of animals.

Lab Policies:

SAFETY – Each person is responsible for adhering to all lab safety guidelines including proper attire for lab experiments. Wearing closed-toed, closed-heel shoes are required by OSHA regulations. **Failure to wear closed-toed, closed-heel shoes will result in denial of access to the lab and loss of points for that lab.** Actions that create or contribute to an unsafe environment for you or anyone else in the laboratory will not be tolerated. Such actions mean you will be asked to leave; all points for that lab may be forfeit**.**

DISSECTIONS – Dissections of plant and animal material do occur in this laboratory and you are expected to participate in the process.

EXAM CONFLICTS WITH OTHER COURSES – You **will not** be excused from your scheduled lab to take an exam in another course, regardless of whether that course exam was scheduled prior to enrollment. If you chose to come to lab late or skip lab, you will forfeit all points for that lab period.

Alternative accommodations for exams in other courses scheduled during your registered lab time must be made by your 'exam' instructor, not by your Biology instructor. **You should contact the instructor of the other course well in advance of the exam to make other testing arrangements**. **University policy on this situation is clear and can be found in the ISU Catalog at http://catalog.iastate.edu/academiclife/#examinations. It states:**

> *Students who are unable to take a separately scheduled examination at the scheduled time … because of a course conflict… must notify the* (exam) *instructor in advance and must be given the opportunity to be examined at another time mutually convenient for the student and the instructor. The instructor shall determine whether to administer the same examination or an alternate examination, or use an alternate assessment procedure.*

If your exam instructor is not willing to make a suitable accommodation, you may contact the Academic Dean of Students at 1010 Student Services Building, (515) 294-1022.

ABSENCES – If you miss a lab, you will likely forfeit the points for that lab session**. There are no make-up labs**. You are responsible for notifying your lab instructor **as soon as possible** if you must miss a lab and arranging to turn in assignments and learn about new assignments. Delay in notifying your lab instructor and lack of an excused absence will result in a loss of points for that lab session. It is sometimes possible to attend an alternative lab section (see **Attending Alternative Lab Sections**)

Excused absences due to professional meetings and/or University athletic team obligations require you to bring a sponsor's or advisor's letter indicating your required attendance at that event. These letters must be presented to the **lab coordinator** prior to the event in order to make lab accommodations. Participation in recreational sports, clubs, volunteer organizations, or Greek activities **are not considered excused absences**. Your academic course work takes first priority. Absences due to **serious** illness require a doctor's note.

ATTENDING ALTERNATIVE LAB SECTIONS – Students **cannot** attend lab sections for which they are not officially

enrolled without special permission from the **lab coordinator**. Lab instructors are required to deny lab access to students from other sections who lack a signed admission slip from the coordinator for an alternate lab section.

To attend an alternate lab, you must complete an "Alternate Lab Request" form (found in BlackBoard) and submit it to the lab coordinator (instructions on the form) for approval. If space is available, you will receive approval and will need to pick up the admission slip posted on the coordinator's office door. Alternate lab requests must be submitted at least a day in advance – earlier is better. If you do not provide sufficient time for the coordinator to respond, your request cannot be approved.

Pre Lab Quizzes and Protocols– No pre-lab quizzes or protocols will be accepted after the lab starts. All pre-labs are open book and you are encouraged to use your text when answering questions for the pre-lab. Each student is allowed 2 attempts to complete each pre-lab quiz on Blackboard. Protocols are due at the beginning of lab. Each student should bring two (2) copies of their protocol to lab.

Late Assignments– Late assignments will have points deducted. All late assignments will have 1 point deducted per day, up to 1/3 of the total point value. It is the responsibility of the student to communicate with their graduate teaching assistant to have late assignments graded.

Post Lab Quizzes– For lab weeks when there are Post-Lab Quizzes, they are administered at the very beginning of the lab period. Students who are late to lab and miss the quiz will forfeit the points. Students may use their own notes, drawings or printed photos that they took in lab, but use of **books, computers, cell phones, Lab Supplemental Materials or lab manuals** is prohibited. Collaboration and sharing answers is not permitted.

Academic Dishonesty– Any evidence or suspicion of Academic Dishonesty will be forwarded to the Academic Dean in the Office of Judicial Affairs. It is your responsibility to be informed regarding Academic Dishonesty criteria and policies. These policies are described at:http://www.public.iastate.edu/~catalog/2009-2011/geninfo/dishonesty.html.

Note: Students in this course often work together in the lab to collect data and information. Collaborative learning is encouraged. However, any assignment submitted for grading must be the individual student's original work. Copying work of others, including graphs, tables, text, or illustrations; providing such work for others to copy, and submission by different individuals of collective answers from the group are considered dishonest.

LETTER GRADE GUIDANCE – The following grading scale has been used over several years in this course, and you can consider it a 'guideline' to probable letter grades. The actual scale in any semester will be determined after scores from all sections have been compiled, but letter grade boundaries will not be raised above those posted below.

A	92-100%
A-	90-91
B+	88-89
B	82-87
B-	80-81
C+	78-79
C	72-77
C-	68-71
D	60-67
F	<60%

Iowa State University is "dedicated to fostering an environment in which differences in people such as nationality, race, gender, religion, cultural background, physical ability, and sexual orientation, are respected and mutual understanding is promoted." (from the ISU Bulletin) If you have a disability and require accommodations, please contact the instructor early in the semester so that your learning needs may be appropriately met. You will need to provide documentation of your disability to the Disability Resources (DR) office, located on the main floor of the Student Services Building, Room 1076, 515-294-7220. The DR office will provide you with the appropriate documentation to give to your Teaching Assistant.

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Class Schedule

Week 1 – Quantitative techniques

- Use of micropipetters, spectrophotometer
  - variation in absorbance with wavelength
  - use of standard curve to estimate concentrations
- Use Excel to graph data, compute regression lines and simple statistics – mean, SD, r^2

Week 2 – Biomolecules

- Molecular modeling with Jmol
- Structures of carbohydrates, lipids, peptides, nucleic acids
  - Polymers and monomers
  - Functional groups, electrical charge and solubility
  - Fatty acid saturation/unsaturation
  - Levels of protein structure (primary, secondary, tertiary, quaternary); significance of structure
  - DNA structure
    - nucleotide monomers, covalently linked polymers
    - base pairing and hydrogen-bond linked double helices
      - functional importance in DNA replication

Weeks 2-10 – Plant hormone research project - student designed research

- Design procedure to describe growth characteristics of plant seedlings, and experiments to determine whether growth is affected by addition of a plant hormone (Gibberellic Acid and/or Abscissic Acid).
- Experimental design – proper controls, replication, group collaboration
- Formal write-up (requires references from primary research literature)

Week 3 – Enzymes

- Extract peroxidase from turnip
- Measure reaction rate of peroxidase-catalyzed reduction of hydrogen peroxide
  - Spectrophotometric measure of color change as electron donor (guaiacol) is oxidized
    - Plot color change vs time, calculate slope = reaction rate
  - Measure effect of pH and temperature changes on reaction rate
  - Measure effect of hydroxylamine, a molecule similar to hydrogen peroxide in size and shape
  - Measure effect of high temperature (boiling) on peroxidase activity
  - Re-plot data to show reaction rates, not absorbance, as dependent variable
  - Understand measured effects by revisiting peroxidase structure using Jmol
  - Calculation: catalytic action of peroxidase

Week 4 – Cell and tissue respiration

- Yeast respiration
  - Contrast end products of fermentation and aerobic respiration
    - Qualitative assays – CO_2 production, ethanol production
    - Contrast growth rates of aerobic and anaerobic cultures
- Measure rates of oxygen consumption by germinating seeds
  - Manometric technique, Standard temperature and pressure
  - Effect of short term exposure to freezing temperatures

Week 5 – Photosynthesis

- Chlorophyll structure and function
- Chlorophyll extraction
  - Molecular structure and solvent partitioning
- Measure chlorophyll absorption spectrum
- Measure photosynthetic rate as function of light intensity
  - Manometric technique – rate of oxygen production

Week 6 – DNA extraction and bacterial transformation

- Review DNA structure
- Extract DNA from onion
  - Solvent partitioning, temperature effects on solubility
  - DNA molecular length
- Bacterial transformation (Results in Week 7)
  - Plasmid and genomic DNA
  - *E. coli* transformed with ampicillin resistance + green fluorescent protein plasmids
    - Transformation concept
    - Heat shock and elevated calcium alter bacterial competence for DNA uptake
    - Selection media and reporter genes
    - Transformation efficiency
    - Plating technique and colony counting
  - Implications – genetic engineering and multi-drug resistance
  - Plant hormone experiment set-up.

Week 7 – Bacterial transformation data analysis, Plant Cells and Tissues

- Analysis of Week 6 bacterial transformation results
- Plant cell structure (light microscopy) and function
  - Primary and secondary cell walls, plasmodesmata, plastids, vacuoles
- Plant tissue types
  - dermal tissues – epidermis, trichomes and ground tissues (parenchyma, collenchyma, sclerenchyma)

Week 8 – Plant vascular tissues and plant hormone research project data collection

- Vascular tissues microanatomy – tracheids, vessel elements, sieve tube members and companion cells
- Plant vascular tissue
  - Xylem and phloem structure and function
  - Water transport - xylem flow
    - Evaporation-cohesion-tension model tests
      - What drives xylem flow? Compare water uptake in leafy and leafless celery petioles.
      - Is xylem sap under **tension**? How does xylem fluid move from cut across wheat or oat leaf?
      - How does dehydration affect xylem tension in wheat or oat leaves?
- Measure seedlings and record data from *Arabidopsis plant hormone* research project.

Week 9 – Plant organ systems: roots, stems and leaves. Plant growth

- Meristematic tissues - apical and lateral meristems (cambiums)
- Root structure and function
  - endodermis and vascular cylinder (monocot/eudicot comparison), root hairs
- Stem structure and function
  - Vascular bundles (monocot/eudicot comparison), primary and secondary growth, wood production
- Leaf structure and function
  - Leaf morphology, shapes and tissues, stomate structure and function

Week 10 – Animal digestive, renal, and reproductive systems

- Fetal pig dissection **-** Location and function of gastrointestinal, renal and reproductive organs
  - Thymus, thyroid, and spleen anatomy and function included
  - Mammal pharyngeal anatomy
  - Location & functions of digestive tract accessory organs - salivary glands, pancreas, liver & gall bladder
  - Intestinal anatomy – small intestine rugae, villi, microvilli and functional importance
  - Kidney structure and function – filtration, reabsorption, secretion
  - Testes and ovaries - gamete production and pathways of gamete movement
  - Uterus of pregnant pig - embryos and placenta

Week 11– Mammal Circulatory System

- Fetal pig dissection
  - Mammal cardiac anatomy and major blood vessels
  - Flow pattern through mammalian heart
  - Pulmonary bypass (right-left shunts) in embryos
    - Foramen ovale
    - Ductus arteriosus
- Artery and vein structure and function
- Capillary blood flow
- Measurement of human heart rates and blood pressures
  - Effect of exercise, hypertension and its health consequences

Week 12 – Animal Gas Exchange Systems

- Dissection anatomy of insect tracheal system; fish gill; fetal pig trachea, bronchi, and lung
  - Comparison of adaptations for gas exchange – large surface area, minimal diffusion barrier
  - Mammalian ventilation
    - Location and function of diaphragm and intercostal muscles
    - Measure lung ventilation capacities and flow rates of student subjects
      - Tidal volume, ventilation frequency, inspiratory and expiratory reserve volumes, vital capacity
    - Consequences of increasing dead space.

Week 13 – Neural and Sensory Systems

- Central nervous system gross anatomy (fetal pig, brains of adult pigs)
  - Gray matter and white matter – functional interpretation. Major brain structures
- Peripheral nervous system –anatomy of sympathetic ganglia and spinal nerves
- Stretch reflex
- Neuron anatomy
  - Spinal cord squash – cell bodies and parts of axons and dendrites, neuromuscular junction
- Eye structure and function
  - Dissection of preserved mammal eyes
  - Blind spot demonstration - central nervous system fudges perception

Color vision - afterimages demonstrate wavelength-dependent responses of cone populations

Week 14 – Animal muscles and skeletons

- Microscopic anatomy of skeletal, cardiac, and smooth muscle
- Muscle experiment (mechanisms of motor control – students as subjects)
  - Electrically stimulate motor nerve in forearm, record finger twitch response
    - Recruitment – effect of increasing stimulus amplitude
    - Temporal summation – effect of increasing stimulus frequency
- Mammal bone structure
  - compact and cancellous (spongy) bone, epiphyses and diaphysis, marrow\
  - collagen component (decalcified bones)
  - Microscopic study of bone (Haversian systems, lacunae) - cellular & extracellular components of bone
  - Names and locations of major tetrapod skeletal elements
- Comparative study of exoskeletons (insect, crustacean) and endoskeletons (squid or cuttlefish, human, rat, bat, bird, snake, turtle)

Week 15 – In lab practical exam