



GENERAL BIOLOGY I - BIOLOGY 006

5.00 units (UC:CSU transferable)

Section 0412

Fall 2015

Professor: Patricia Zuk, PhD

email: zukp@wlaac.edu

LECTURE: MSA Rm. 303

9:35am – 11:00 am

LABORATORY: MSA Rm. 303

12:00pm – 3:15pm

OFFICE HOURS: by appointment or from:

1. 3:30 to 4:30 PM Monday through Thursday
2. Office is MSB Room 210

PREREQUISITES: Biology 3A/3B. High school AP biology or introductory college biology may also be accepted with permission of instructor. Chemistry 101 with a grade of 'C' or better. Intermediate Algebra with a grade of 'C' or better

COURSE DESCRIPTION: General Biology I/Biology 6 is the first of a two semester general biology series for Biology Majors, pre-Medical, pre-Dental, pre-Pharmacy. The principles of molecular biology, cell structure and function, genetics, reproduction and organization at the tissue level in plants and animals are covered. Biology 6 and 7 satisfy requirements of lower division biological science majors at the UC and CSU systems.

ATTENDANCE: Attendance is mandatory (see Administration Regulation E13). If enough absences occur throughout the semester, I can exclude you from the course. Be aware that your grade in this course depends on your performance – which is dependent upon your attendance. **I guarantee if you miss too many classes and labs – you will fail the course.**

Lectures begin at 9:35am and run until 11:00am. You have a lunch break until 12:00pm. At this point, the laboratory section of the course begins. Each laboratory is preceded by a lecture portion and will cover the concepts of the laboratory for that day. These lectures are often an extension of the morning session. So being late for lab means you will miss part of this lecture. Labs run until 3:15pm.

Since biology labs cannot be duplicated outside the class it is very important for you not to miss any labs if possible. You also must plan on attending the entire lab period. When you are finished the labs – to my satisfaction – you may leave quietly without disturbing your fellow lab mates.

I consider extreme tardiness or early departure from lab/lecture without a valid cause to be very disrespectful conduct. However, I realize traffic and life gets in the way sometimes. So being late and having to leave early is fine – every now and then. **Do NOT insult me or your classmates by consistently showing up late to lecture/lab every time!!!**

DO NOT EVEN CONSIDER BEING LATE IF THERE IS AN EXAM SCHEDULED. I will NOT give you the exam if you are more than 10 minutes late and have provided me with a valid excuse for your tardiness that day!! If you have conflicts in your schedule – come and talk to me. I am very understanding about many things and do not bite my students (much!). Also, exchange numbers with your lab-mate so that if you are running late for an exam you can relay a message to me through them.

WITHDRAWING FROM THE CLASS: Any student withdrawing from the class must inform the admissions office and complete the required steps. Students failing to follow the correct procedure for withdrawing will receive an ‘F’ at the end of the semester. I will not be held responsible for your grade if you fail to correctly withdraw from this course. Therefore, confirm your registration status. Finally, there are deadlines for withdrawing without a “W”, with a “W” and a deadline where withdrawing is no longer possible. Be aware of these dates.

COURSE CONSTRUCTION: This course is comprised of two weekly lectures/labs that total over 9 hours per week! This is a lot of lecture time and a lot of lab time. Breaks will NOT be given during these sessions. However, you will have 120 minutes in between the morning and afternoon sessions to recharge your batteries. The first 30 minutes of this break has been set aside as my office hours.

The morning session is approximately 90 minutes of lecture. These lectures cover the major topics in your biology textbook and will coincide with what we will be studying in the afternoon laboratory session. The afternoon session is 3hrs and 15 minutes of lab time. However, the first 60 to 90 minutes will be a lecture that covers the specific concepts of that lab topic or continues on what we were covering in the morning session. The last 2 hrs will be devoted to team lab research. This material will be covered in your lab manual or in handouts that I distribute to you.

You are welcome to tape my lectures. I also have my own personal website – www.patriciazuk.com where the lecture presentations can be found along with additional learning materials. This website is password protected with the username of **student** and the **case-sensitive password** of **#1Wlacstudent**. The lectures on this site are “student lectures” and do NOT contain every detail you will find in my lecture presentations or will hear throughout my lectures. This is so that you are required to pay attention and write some things down. Therefore, please print out these lectures and bring them to class so that you may supplement them throughout the lecture/lab period with your own notes taken during class. You will also be required to re-create simple figures and diagrams that I will present to you throughout lecture.

Videos shown in lecture and lab are to be considered as important as lecture and you should pay close attention to the material presented in them.

Handouts will be given in class so be sure to pick them up the day they are offered. I am not guaranteeing that these handouts will be available after the day I offer them.

LABORATORIES: Each afternoon session is 3 hours and 15 minutes long. The first 60 to 90 minutes will be lecture material pertinent to that lab session. Please bring your lab manual or lab handouts to each lab as your assigned material will be in that lab manual. If no lab is planned, then the first 60 to 90 minutes will be used as a continuation of your morning lecture section.

You will work in teams of 2 or 3 for each lab but are also encouraged to interact with other groups throughout the lab. Each student will keep a lab manual for their observations and conclusions. This lab manual should be a spiral bound notebook of at least 200 pages and must be kept as a separate notebook. Each lab session will be recorded in this book. Use the format below for each lab:

1. each lab must be titled and dated
2. the first pages of each lab may be used for notes from the introductory lecture given at the start of the lab. Label this section as Introduction.
3. each lab should list a statement of purpose and any objectives of the lab. Label this section as Specific Aims.
4. following the instructions for each lab outlined in your lab manual, create the required graphs, charts and diagrams in your notebook and answer each question in a clear and succinct manner. Label this section as Data & Observations.

5. conclude each lab with some brief statements as to how your data and observations related to the introductory lecture. Label this section as Conclusions

WEST LA COLLEGE STUDENT LEARNING OUTCOMES (SLOs): West LA College as an institution is committed to an environment of learning and respect for its students. Its mission is to serve the community by providing quality instructional services through its programs and facilities. The college has created a series of Student Learning Outcomes (SLOs) that are designed to maximize the successes and experiences of the students here at WLAC.

A. Critical Thinking: Analyze problems by differentiating facts from opinions, using evidence, and using sound reasoning to specify multiple solutions and their consequences.

B. Communication: Effectively communicate thought in a clear, well-organized manner to persuade, inform, and convey ideas in academic, work, family, and community settings.

C. Quantitative Reasoning: identify, analyze, and solve problems that are quantitative in nature.

F. Technological Competence: Utilize the appropriate technology effectively for informational, academic, personal, and professional needs.

BIOLOGY PROGRAM SLOs: In addition, the Biology program also has several unique SLOs. A student who completes this program will be able to:

1. Explain how scientists investigate causes of natural biological phenomena.
2. Explain how living things are organized, reproduce, acquire matter & energy, and inherit & express genetic instructions.
3. Utilize biological information to make informed decisions about environmental issues.
4. Utilize biological information to make informed decisions about personal issues.
5. Perform basic biological lab procedures.

STUDENT LEARNING OUTCOMES FOR BIOLOGY 6: At the end of the semester, the students should understand and be able to explain the fundamental concepts of the following:

1. the chemical composition of life, including the four organic macromolecules found in organisms
2. the major components of both prokaryotic and eukaryotic cells and the function of eukaryotic organelles
3. the major cellular processes of eukaryotic cells such as membrane transport, cell division/mitosis, DNA replication, RNA transcription, protein translation, cellular organization and secretion and energy production
4. Mendelian genetics and the chromosomal basis of inheritance.

LEARNING OBJECTIVES FOR BIOLOGY 6: In addition to overall learning outcomes, there are multiple subject and technical objectives that the students should achieve by the end of the semester. These objectives encompass many of the major themes presented in this course, in addition to covering more specific topics.

SUBJECT OBJECTIVES: At the end of the semester the students should demonstrate proficiency in understanding and explaining the following:

1. The concept of concentration and molarity, including how to determine molar mass and how to prepare specific solutions if given molarity
2. The structure of an atom and how it influences the creation of a chemical bond
3. The types of chemical bonds and chemical reactions
4. The structure and function of the four major macromolecules: carbohydrates, lipids, proteins and nucleic acids
5. The major components of a cell, both prokaryotic and eukaryotic
6. The structure and function of the plasma membrane, including how the membrane controls transport and the types of transport capable of occurring across a membrane
7. The structure and function of the nucleus, including how DNA is organized in both prokaryotes and eukaryotes, how DNA is replicated and how RNA is transcribed.
8. The composition of the cytoplasm, including the components and function of the cytosol and cytoplasm
9. How cells divide through mitosis, including the roles of the centrioles and spindle
10. The process of protein synthesis, including protein translation, the four levels of protein organization
11. The structure of function of the following organelles: the endoplasmic reticulum, Golgi apparatus, lysosomes and peroxisomes
12. The control of DNA replication and RNA transcription, including the cell cycle and its role in abnormal processes like cancer
13. The control of both prokaryotic and eukaryotic gene expression
14. The role of the mitochondria and ATP in the bioenergetics of a eukaryotic cell, including understanding the steps of glycolysis, Krebs's cycle and the electron transport chain
15. The process of photosynthesis in plants, including the structure of a chloroplast, the role of chlorophylls and other photosynthetic pigments, the photosystems and Calvin cycle
16. How organisms produce gametes through meiosis and how this process results in genetic diversity
17. The concepts of Mendelian genetics: phenotype, genotype, alleles, homozygous and heterozygous
18. How Mendelian genetics can explain how DNA and phenotypic traits are passed through generations

19. The more advanced concepts of genetics and chromosomal inheritance such as co-dominance, multi-allele traits, sex-linked traits and gene linkage
20. How alterations in chromosomal number can occur and result in genetic disorders
21. How cells interact and communicate with one another, including the production and function of hormones, growth factors and the cell signaling pathways
22. How cells interact to produce tissues and the major types of tissues observed in organisms
23. The concepts and stages of embryonic development, including the early stages of cleavage, blastula and gastrula formation, morphogenesis and organogenesis.

TECHNICAL OBJECTIVES: Add the end of the semester, the student should be able to perform the following within a laboratory setting:

1. Weighing a given substance using a balance beam
2. Determining the absorbance of a given solution using a spectrophotometer
3. Detection of a sugar, lipid, protein or nucleic acid using specific stains
4. The proper operation of a compound and dissecting microscope, including being able to properly visualize cells and tissues
5. The identification of some of the major components of a plant and animal cell, such as the cell wall, vacuole and nucleus
6. The set up and performance of an experiment to illustrate the processes of diffusion and osmosis, including being able to determine diffusion rate and how solute concentration can affect osmosis
7. The simulation of DNA replication, RNA transcription and protein translation if given specific DNA sequences
8. The identification of the stages of mitosis and meiosis using both prepared slides and models
9. The completion of genetic problems, including determining allele frequency, genotypes and phenotypes using Punnett squares and a pedigree chart
10. The identification of the major tissue types: epithelial, connective, muscular and nervous, including their subtypes
11. The isolation of DNA using cells taken from the inside of their own cheek
12. The production and analysis of a DNA fingerprint, including being able to make an agarose gel, run the DNA using that gel and analyze the resulting DNA migration pattern

COURSE MATERIALS: be sure to bring these to each class

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1. Textbook: Campbell Biology – Campbell, Reece et al. 9th Edition. Benjamin Cummings Publishing.

2. Lab Manual: Available in the bookstore. You **MUST** purchase this lab manual for it contains all of the labs you will perform in this course.

3. Lab notebook: This will be a spiral bound notebook of at least 200 pages and is available at the bookstore. This book will be used to record your laboratory observations

4. Lecture notebook: The type you use may be your own preference but please purchase a separate notebook from that of your lab manual. This book will be used to supplement the lectures given in the morning and afternoon sessions. You should also print out the lecture slides prior to coming to class and put these in your notebook. As a result, a three-ring binder may be a good option. That way you can place your notes and the printed slides together in the same notebook.

5. Numerous colored pens and pencils for lectures and labs

6. Scantron 882E forms for exams

EXAMINATIONS: You will have two different types of exams: Lecture exams and Laboratory exams. Lecture exams will be worth 100 points. These exams will be multiple choice, fill in the blank, short answers and may include figures from my notes and from the text that you will have to complete. These exams will range anywhere from 50 to 100 questions. You will use your lecture notes to study for this exam.

Each laboratory exam will be worth 50 points. These exams are based on your afternoon lab sessions. They will also include multiple choice and fill in the blank questions and may also include identification questions using images projected by the computer. The exams will range anywhere from 35 to 50 questions. You will use your laboratory notebook to study for this type of exam.

There will be a final exam held during the exam period. It will be a **cumulative exam worth 150 points**. This exam will encompass materials given during the lecture and lab sessions throughout this course. Like your previous exams, it will include multiple choice, true/false, fill in the blank and short answer questions.

I will discuss each exam and what to expect– so don't freak out! I may also provide you with some study guides to ensure you are keeping yourself on track during your study times. But don't count on it! This is a majors biology course so you are expected to know what could be on an exam.

Exam breakdown:

Lecture exams = $4 \times 100 = 400$ points

Laboratory exams = $3 \times 50 = 150$ points

Final cumulative exam = 150 points

Total points = 700 points

I do not allow you to keep any tests so please keep track of your performance in the class by recording all your exam scores.

Cheating will NOT be tolerated. ANY STUDENT FOUND CHEATING WILL RECEIVE THE GRADE OF 'F' FOR THAT EXAM AND MAY BE EXPELLED FROM THE COURSE!!!

Schedule of Topics

Section	Text Chapters	Date	Lecture Topic Lab Topic
Introduction	Ch. 1	08/31	An introduction to science Lab 1: The Metric System
	Ch. 2 & 3	09/02	The chemical context of life Lab 2: Molarity Lab
		09/07	LABOR DAY – NO CLASS
	Ch. 4 & 5	09/09	Organic molecules Lab 3: Spectrophotometer lab
	Ch. 4 & 5	09/14	Organic molecules cont... Lab 4: Chemical analysis lab
	Ch. 6	09/16	An introduction to the cell Lab 5: Introduction to the cell
		09/21	AM: LAB EXAM 1 PM: LECTURE EXAM 1
The Cell – Cellular Processes and Cellular Control	Ch. 6	09/23	Cellular processes – the Plasma Membrane Lab 6: Diffusion Lab
	Ch. 16	09/28	Cellular processes – the Nucleus DNA replication Lab 7: Osmosis Lab
	Ch. 12	09/30	Cellular control – Control of DNA Replication The Cell Cycle Lab 8: Mitosis Lab
	Ch. 17	10/05	Cellular processes – the Cell Cycle cont.... Lab 9: Genes in a Bottle Lab
	Ch. 6	10/07	Cellular processes – from the Nucleus to the Cytoplasm Transcription & Translation Lab 10: DNA Transcription & Translation Lab & Exercises
	Ch. 18	10/12	Cellular control – Control of gene expression Control in bacteria – the Operon Lab: Agarose gel electrophoresis
		10/14	Cellular control – Control of gene

			expression Control in eukaryotes No lab planned – AM & PM Lectures
		10/19	Cellular control – Control of gene expression cont.... No lab planned – AM & PM Lectures
	Ch. 12 & 18	10/21	Cellular processes – The Cytoplasm & Cytoplasmic Organelles The Cytoskeleton Non-membranous vs. membranous organelles No lab planned – AM & PM Lectures
		10/26	AM: LAB EXAM 2 PM: LECTURE EXAM 2
The Cell - Bioenergetics		10/28	Bioenergetics – An introduction to metabolism No lab planned – AM & PM Lectures
	Ch. 8	11/02	Bioenergetics – Cellular Respiration Lab 11: Fermentation & Cellular Respiration Lab
	Ch. 9	11/04	Bioenergetics – Cellular Respiration cont... Bioenergetics – Photosynthesis No lab planned – AM & PM Lectures
		11/09	AM: NO LAB EXAM PM: LECTURE EXAM 3
Genetics		11/11	VETERAN'S DAY – NO CLASS
	Ch. 13	11/16	Genetics – Sexual life cycles Meiosis & genetic variation Lab 12: Meiosis Lab
	Ch. 14	11/18	Mendelian Genetics Lab 13: Genetics Lab #1
	Ch. 15	11/23	The chromosomal basis of inheritance Lab 14: Genetics Lab #2
		11/25	AM: LAB EXAM 4 PM: LECTURE EXAM 4
Embryology & Development	Ch. 47	11/30	Animal Development Lab 15: Vertebrate development

		12/02	Animal Development cont... <i>No lab planned – AM & PM Lectures</i>
		12/07	Animal Development cont... <i>No lab planned – AM lecture</i>
		12/09	AM: LAB EXAM 5 PM: LECTURE EXAM 5
		12/14	PRESENTATION DAY
		12/16	CUMULATIVE FINAL EXAM (LECTURE AND LAB)

Overview of Covered Topics

Lecture #1: An introduction to Science (Chapter 1)

- themes in the study of life
- levels of biological organization
- Core theme: Evolution accounts for the unity and diversity of life
 - diversity of life
 - 3 domains of life
 - natural selection
 - descent with modification – the tree of life
- Scientific method: asking questions and testing hypotheses
 - types of data
 - inductive reasoning
 - deductive reasoning & hypothesis testing
 - flexibility of the scientific method
 - proper experimentation – controls and repeatability
- Theories in science

Lecture #2: The chemical context of life (Chapters 2 & 3)

- the chemical connection to biology
- elements and compounds
- the elements of life
- atoms and its components
- isotopes and radioactivity
- molecules and chemical bonds
- chemical reactions
- Water: polar covalent bonds and hydrogen bonding
 - properties of water: cohesion, temperature modification, specific heat, density
 - water as a solvent: hydrophilic vs. hydrophobic
 - solute concentration in water – Molarity
- Acids & bases: pH scale
 - buffers
 - acidification

Lecture #3: Organic molecules (Chapters 4 & 5)

- Carbon: the backbone of life
 - properties of carbon
 - hydrocarbons & their isomers

-functional groups in biology

-organic molecules

-macromolecules & polymers:

-diversity of polymers

1. carbohydrates – types of polysaccharides

2. lipids – fatty acid structure and the types of lipids

3. proteins – amino acids and polypeptides

-protein structure and levels of organization

-protein function

-chaperonins and protein folding

4. nucleic acids – types and structure

-DNA and RNA structure

-ATP - a modified nucleotide

Lecture #4: Introduction to the cell (Chapter 6)

-the cell theory

-types of microscopes

-four components of a eukaryotic cell:

1) the plasma membrane – intercellular junctions & adhesions, membrane proteins

2) the cytoplasm & cytoskeleton – cilia and flagella

3) the nucleus – forms of DNA (ch. 12)

4) cytoplasmic organelles – membranous and non-membranous

Lecture #5: Cellular processes – the Plasma Membrane

-the plasma membrane and transport mechanisms

-passive mechanisms – diffusion, osmosis and facilitated diffusion

-active mechanisms – primary and secondary transport, exocytosis, endocytosis

Lecture #6: Cellular processes – the Nucleus & DNA replication (Chapter 16)

-organization of DNA in the nucleus – chromatin & histones

-problems with DNA replication

-the machinery of replication – polymerases

-DNA repair mechanisms

Lecture #7: Cellular processes – from nucleus to cytoplasm – transcription & translation (Chapter 17)

-the transcription unit

-transcription: DNA to RNA

- types of RNA
- mechanisms of transcription – the RNA polymerase
- modifications of mRNA – the cap and the polyA tail
- promoters

-translation: mRNA to protein

- the ribosome
- tRNA function and structure
- the genetic code and codon table

Lecture #8: Cellular processes – the Cytoplasm (Chapter 12)

- cilia and flagella – dynein motors
- actin microfilaments and cellular movement
- actin and myosin interactions – muscle contraction
- non-membranous organelles – the centriole
- the mitotic spindle
- mitosis and cytokinesis
- evolution of mitosis – prokaryotic binary fission

Lecture #9: Cellular processes - the Cytoplasm cont....

- membranous organelles
- protein synthesis:** ribosomes, the RER and the Golgi
 - protein modifications – folding, glycosylation, proteases
 - protein trafficking – sorting signals
- lipid synthesis:** the SER
 - lipid biosynthesis
- waste management:** peroxisomes and lysosomes
 - functions and diseases

Lecture #10: Cellular control – Control of DNA (Chapters 12 & 18)

- regulation of DNA replication – chromatin/chromosome structure and histone modification (ch. 18)
 - histone acetylation
- regulation of DNA replication – the cell cycle (ch. 12)
 - phases of the cell cycle
 - checkpoints
 - cyclins and cdks
 - loss of control – cancer
 - the G0 phase

Lecture #11: Cellular control – Control of gene expression (Chapter 18)

-control in bacteria – the operon model

- repressible and inducible – negative regulation
- cAMP and positive regulation

-control in eukaryotes – stages of control

- differential gene expression
- regulation of transcription – transcription factors & enhancers
- coordinately controlled expression

-post-transcriptional control – mRNA degradation

- splicing and the spliceosome
- initiation of translation – the UTR and the polyA tail
- protein processing – phosphorylation, cleavage
- protein degradation – ubiquitin & the proteasome

-role of non-coding RNAs – miRNA & siRNA

Lecture #12: Bioenergetics – Metabolism (Chapter 8)

-forms of energy

-laws of thermodynamics

-free energy change – stability and equilibrium

-free energy and metabolism

-review of ATP and ATP hydrolysis

-activation energy – exergonic reactions

-activation energy & enzymes – substrate specificity

-catalysts and cofactors

-regulation of enzyme activity – allosteric regulation and regulatory molecules; feedback inhibition

Lecture #13: Bioenergetics – Cellular Respiration (Chapter 9)

-production of ATP – aerobic respiration vs. fermentation

-redox reactions

-NAD⁺ as an electron acceptor

-cellular respiration – review of the mitochondria

-glycolysis

-citric acid cycle

-chemiosmosis & the electron transport chain

-ATP “accounting”

-anaerobic respiration vs. fermentation

-types of fermentation

- anaerobes
- connections of glycolysis and the citric acid cycle to other metabolic pathways
 - use of fats and proteins as energy
 - connections to biosynthesis (anabolism)
- control of cellular respiration reactions

Lecture #14: Bioenergetics – Photosynthesis (Chapter 10)

- chloroplasts – a new organelle
- the reactions of photosynthesis
- light reactions – the nature of sunlight
 - chlorophylls and carotenoids
 - photosystems
 - linear and cyclic electron flow
 - chemiosmosis – chloroplasts vs. mitochondria
- dark reactions – the Calvin cycle
 - reduction of CO₂ to sugar
 - carbon fixation, reduction & regeneration
- C₃, C₄ and CAM plants - adaptations

Lecture #15: Genetics – Sexual Life Cycles (Chapter 13)

- inheritance of genes
- sexual vs. asexual reproduction
- chromosome types – diploid vs. haploid, karyotypes
- variety in sexual life cycles – alternation of generations
- meiosis – stages
- comparing mitosis with meiosis
- genetic variation by meiosis
 - crossing over in recombinant chromosomes
 - independent assortment
 - random fertilization
- evolutionary significance of meiosis

Lecture #16 – Mendelian Genetics (Chapter 14)

- Mendel's experiments – pea plants, P and F generations
- Law of Segregation
- Mendelian model of inheritance
 - genotypes, phenotypes, alleles
 - Punnett squares and test crosses

- Law of Independent Assortment – monohybrid vs. dihybrid
- laws of probability – monohybrid crosses
 - multiplication rule – i.e. the Product rule
 - addition rule – i.e. the Sum rule
- probability and dihybrid crosses
- complex inheritance patterns – single genes
 - degrees of dominance
 - multiple alleles – blood groups
 - pleiotropy and multiple phenotypes
- complex inheritance patterns – multiple genes
 - multiple loci and epistasis
 - polygenic inheritance
- nature and nurture: the impact of the environment
- pedigree analysis – analyzing the behavior of human traits

Lecture #17 – The Chromosomal Basis of Inheritance (Chapter 15)

- correlation behavior between a gene allele and its chromosome – Morgan and the fruit fly
- sex-linked genes
 - inheritance of X-linked genes
 - X inactivation in females
- linked genes and inheritance
 - genetic recombination – crossing over
 - linkage maps
- alterations in chromosome number
 - non-disjunction – aneuploidy and polyploidy
- alterations in chromosome structure
 - inversions, deletions and translocations
- genomic imprinting
- inheritance of organelle genes – extranuclear genes

Lecture #18: Animal Development (Chapter 47)

- fertilization mechanisms
- cleavage patterns
- gastrulation – sea urchin, frog, chick
- embryonic germ layers
- neural crest cells and the neural tube
- mechanisms of morphogenesis
 - the role of the cytoskeleton

- apoptosis
- fate determination
 - determination vs. specification
 - fate mapping
- induction in embryogenesis
 - Spemann's organizer
 - chick limb bud development