

SYLLABUS

Name of Course: Biomechanics of the Spine - TECH-216

Length of Course: 3.5 units, 55 Hours (5 hours lecture)

Course Description: This course focuses on the spine and how it works as a functional biomechanical unit. The individual joints of the spine are studied, as well as basic principles of biomechanics and kinematics.

Prerequisites: ANAT-118, ANAT-128

Course Offered by: Technique Department

Department Objective: To give to our students, freely and out of abundance, the best of our knowledge and skills. To develop the most talented of chiropractors that they may with skill, both find and correct the vertebral subluxation. To do this for the overall betterment, health, and well-being of their patients and the world.

Required Texts: Biomechanics Manual & Class Notes

Recommended Texts:

1. White & Paujabi *Clinical Biomechanics of the Spine* 2nd Edition 1990
2. Kapandji IA *The Physiology of the Joints. (v.1 Upper Limb, v2 Lower Limb, or v.3 Trunk & vertebral column)??*
3. Harrison DD *Spinal Biomechanics: a Chiropractic Perspective*. 1992
4. Foreman SM *Whiplash Injuries: the Cervical Acceleration Deceleration Syndrome*. 3rd ed. 2002
5. Kirkaldy-Willis WH: *Managing Low Back Pain*. 4th ed. 1999
6. Plaugher G *Textbook of Clinical Chiropractic: a Specific Biomechanical Approach*, 1993
7. Cramer GD *Basic and Clinical Anatomy of the Spine, Spinal Cord and ANS*. 2nd ed. 2005
8. Bogduk N *Clinical Anatomy of the Lumbar Spine and Sacrum*. 4th ed. 2005
9. Standring S *Gray's Anatomy: the Anatomical Basis of Clinical 39th ed. 2005*
10. Yochum TR *Essentials of Skeletal Radiology*. 3rd ed. 2005

Reference Text: See above

Materials: Lecture with overheads, videos, discussion & demonstration.

Evaluation: approximations

<u>Description</u>	<u>Points</u>		
Mid-Term 1	65 points	A – 4.0 Superior	90 – 100%
Mid-Term 2	75points	B – 3.0 Above Average	80 – 89%
Comp Final	90 points	C – 2.0 Average	70 – 79%
<u>2 Articles</u>	<u>10 points</u>		
Total	240 points	F – 0.0 Fail-repeat class	00 – 69%

Extra Credit: There will be no extra credit work accepted in this class.

Articles: Student must review 2 Biomechanics related articles, from current journals in the LCCW Library. Summarize the article, and explain how it is relevant to chiropractic care. Include the site and a copy of the abstract. Due at the end of 5th week. Each article done properly is worth 5 points. Total points: 10.

Grades and the Grading System Final Grades are available online through the CAMS student portal. If there are any questions on grading procedures, computation of grade point average, or the accuracy of the grade report, please contact the Registrar’s Office or the Office of Academic Affairs. Grades will be reported and evaluation will be based on the Academic Policies, Procedures, & Services. Please refer to Evaluation Policy (**Policy ID: OAA.00007**)

In order to maintain Satisfactory Academic Progress, a student must maintain a 2.0 or better in each and every course. Any grade less than a C must be remedied by repeating the class. Please refer to Satisfactory Academic Progress (**Policy ID: OAA.00006**)

Attendance: Please refer to Attendance Policy (**Policy ID: OAA.00002**)

Conduct and Responsibilities: Please refer to the Personal Conduct, Responsibility and Academic Responsibility Policy (**Policy ID: OAA.00003**)

Make-up Exams: Please refer to Make-up Assessment Policy (**Policy ID: OAA.00001**)

Request for Special Testing: Please refer to Request for Special Testing (**Policy ID: OAA.00004**)

Accommodation for Students with Disabilities:

If you have approved accommodations, please make an appointment to meet with your instructor as soon as possible. If you believe you require an accommodation, but do not have an approved accommodation letter, please see the Academic Counselor Lori Pino in the Office of Academic Affairs. Contact info: Lpino@lifewest.edu or 510-780-4500 ext. 2061. Please refer to Service for Students with Disabilities Policy (**Policy ID: OAA.00005**)

Electronic Course Management:

Canvas is LCCW's Learning Management System (LMS). Canvas will be used throughout the quarter during this course. Lectures, reminders, and messages will be posted. In addition, documents such as the course syllabus and helpful information about the class project will be posted. Students are expected to check Canvas at least once a week in order to keep updated. The website address for Canvas is <https://lifewest.instructure.com/login/canvas> Please refer to the Educational Technologies Policy (**Policy ID: OAA.00009**)

Accommodation for Students with Disabilities:

If you have approved accommodations, please make an appointment to meet with your instructor as soon as possible. If you believe you require an accommodation, but do not have an approved accommodation letter, please see the Academic Counselor Lori Pino in the Deans Office. Contact info: Lpino@lifewest.edu or 510-780-4500 ext. 2061.

Course Goals:

Students are presented with a detailed study of the biomechanics of the spine. The functional significance of the spinal articulations, their effect on each other, on the appendicular skeleton, and on selected soft tissue structures. Spinal lesions and abnormal conditions are discussed to illustrate the importance of the normal functioning of the spine, and to illustrate some of the phenomena associated with spinal disorders including the biomechanical aspects of the vertebral subluxation complex. All presentations are made with respect to their relevance to the science, art and philosophy of chiropractic.

Course Objectives:

- Week 1:**
- The instructor will make introductions , call roll, review this document, make any necessary modifications or clarifications and answer any questions.
 - The instructor will review terms and explain some concepts including
 - biomechanics
 - statics/dynamics
 - kinematics/ kinetics
 - functional spinal unit
 - The instructor will introduce core topics in the study of biomechanics and spinal biomechanics in particular :
 - how bodies move in space and interact with forces or objects
 - how bodies deform when under load
 - We will discuss possible causes of the vertebral subluxation and other spinal lesions in the mechanical realm such as:
 - macrotrauma
 - repetitive microtrauma / cyclical loading
 - chronic posture / inactivity
 - We will discuss the intent and effect of the manual , mechanically assisted manual and manually assisted mechanical thrusts.

Week 2:

- Movement and Deformation
- The Instructor will explain different movement ideas such as
 - Displacement
 - Rotation
 - Translation
 - Vectors
 - Orthogonals
- The instructor will demonstrate the right hand orthogonal system.
- The instructor will explain and demonstrate the right hand rotation rule.
- The class will practice manipulating the right hand orthogonal system by applying it to simple spinal movements and listings.
- The instructor will address the interaction of material objects and forces :
 - Load
 - Stress
 - Strain
- We'll differentiate the three fundamental loads;
 - tension
 - compression
 - shear
- Describe and demonstrate the combined loads/stresses :
 - bending
 - torsion

- The Instructor will explain and demonstrate the material properties of biological tissues:
 - elasticity
 - plasticity
 - viscosity
 - strength
- Explain and demonstrate viscoelastic properties including :
 - creep
 - stress relaxation
 - hysteresis
 - fatigue

Week 3:

- Arthrokinematics , Biomechanics of the disc
- The instructor reviews and elaborates on the orthogonal system and describes
- other nomenclatures for planes, axes and movements.
- Demonstrates Coupled Movement:
 - curvilinear movement in the sagittal plane
 - rotational coupling with lateral bending
- Divides the class into small groups to work on :
 - Kaltenborn's convex/concave rule of arthrokinematics
 - Concave/convex rule
- Instructor works with groups to discover the rules of movement

- Instructor describes the anatomy and function of the intervertebral disc (IVD)
- Constituents:
 - H₂O
 - GAGs
 - Type 1 and 11 collagen
 - Chondrocytes
- Organization :
 - Nucleus
 - Annulus Fibrosis
 - Vertebral end plate
- Instructor explains the innervation of the IVD

- Week 4:**
- IVD biomechanics, damage, review, **Mid-Term 1**, spinal ligaments .
 - Instructor explains the response of the IVD to different loads and loading rates.
 - Explains theories of IVD damage and explanations for DDD
 - Reviews material covered to date and answers questions
 - Reviews kinematics of sagittal plane motion and all main motions
 - Administers Mid-Term 1.
 - Reviews the composition, anatomy and function of ligaments
 - Reviews viscoelastic models:
 - elastic
 - plastic
 - viscous
 - Constructs a Kelvin Body in series with an elastic element and demonstrates:
 - reaction to a tensile load
 - reaction to unloading
 - crimp /slack
 - graphic representation of the force/deformation curve

- Week 5:**
- Bone, vertebrae, cervical kinematics, spinal ligaments
 - Instructor describes the general anatomy and function of bone :
 - cortical vs. cancellous
 - bone mass
 - bone strength
 - hormonal and age differences
 - Instructor explains viscoelastic response of cortical and cancellous bone
 - Reviews the remodeling response :
 - Wolfe's law
 - Streaming potentials
 - Reviews the functional anatomy of the cervical spine emphasizing the joint shape and orientation as determinants of the arthrokinematics:
 - lower cervical (LC) flexion/extension
 - LC lateral flexion
 - LC axial rotation

- Upper cervical f/e
- UC lateral flexion
- UC axial rotation

- Week 6:**
- C- spine trauma and instability
 - Introduces the concept of spinal instability due to congenital lesions, trauma, or secondary to pathophysiological processes.
 - Reviews the ADI and discusses lesions which may increase it :
 - trauma
 - Down Syndrome
 - Inflammatory arthropathies
 - Infection
 - Congenital anomalies
 - Shows simple schematics of cervical fractures and discusses the MOIs , exam findings, contraindications to Chiropractic adjustment :
 - Jefferson Fx
 - Wedge Fx
 - Hangman's Fx
 - Dens Fracture's
 - Explains and illustrates other causes of UC instability
 - Review the spinal ligaments in light of possible instability
 - Examines the concept of Anterior Head Carriage
 - Describes the normal cervical curve and discusses:
 - cobb angle
 - military neck
 - s-curves
 - UC compensations
 - deleterious effects on spinal structures

- Week 7:**
- Thoracic spine, rib cage, scoliosis, **Mid-Term 2**
 - Instructor reviews material for Mid-Term 2
 - Administers test
 - Reviews test results answers questions and gets feedback
 - Describes the normal anatomy and kinematics of the thoracic spine and ribs:
 - Bucket handle effect
 - Pump handle effect
 - Rib deformation with axial rotation
 - Coupled F/E
 - Coupled lateral flexion
 - Coupled axial rotation
 - Introduces Scoliosis including terminology, etiology, classifications
 - Discusses Yochum's parameters for evaluation:
 - Curvature
 - Rotation
 - Flexibility
 - Skeletal maturity

- Conducts an exercise wherein Cobb angles are constructed and compared to Reisser-Ferguson angles
- Discusses Chiropractic management of scoliosis and presents a case study

Week 8:

- Lumbar spine anatomy, kinematics, kinetics of lifting
- The instructor outlines the anatomy and function of the lumbar spine
- Explains and illustrates the normal kinematics of the lumbar spine :
 - Coupled F/E
 - Coupled lateral flexion
 - Coupled rotation
- Discusses the normal lordosis and theories regarding
 - hypolordosis
 - hypolordosis
 - sitting and sleeping postures
- Explains and demonstrates lifting theories :
 - muscular strategies
 - musculoligamentous
 - posterior layer of the thoracolumbar fascia
 - stooping and squatting
 - flat back
 - lordotic back

Week 9:

- “Spondyls”, Pelvis: anatomy, kinematics, spine in gait
- Instructor defines the classic spondylolytic spondylolisthesis
- Looks at radiological findings associated with the spondy:
 - Scotty dog
 - Ullman’s line
 - Meyerding’s method
 - Ferguson’s sacral base angle
- Degenerative spondy and associated findings
- Discusses the changing views on disability associated with spondylolisthesis
- Describes the anatomy of the pelvis and sacroiliac joints
- Describes the kinematics of the Coxal bones and sacrum
 - F/E
 - Nutation/counternutation
 - Pubis symphysis
 - Role of the Long dorsal SI ligament
 - Role of the sacrotuberous ligament
- Provides a brief overview of the role of the spine, pelvis and shoulder girdle in the gait cycle

- Week 10:** Leg length inequality, biomechanics of whiplash. Review for final
- Reviews definitions of “leg” and leg length
 - anatomical , structural
 - asymmetrical femurs, tibias , calcanei
 - physiological, functional
 - probable difference in muscle tone or joint flexion angle
 - Demonstrates significant changes in weight bearing leg length with small changes in :
 - hip flexion
 - knee flexion
 - subtalar pronation
 - The instructor describes and demonstrates normal compensations in the pelvis and lumbar spine secondary to LLI
 - Demonstrates Derefield #2 changes with quadriceps contractions
 - Describes basic physics of whiplash accidents
 - momentum
 - acceleration
 - torso/ head displacement
 - Discusses predictability of chronic symptoms and the inadequacy of using objective findings only
 - Review for the comprehensive final

Week 11: Comprehensive Final

Student Learning Outcomes (SLO):

- The student will better understand normal movements of the vertebral segments. [PLO: 1,10]
- The student will be able to describe normal and abnormal movements and joint positions including the use of the orthogonal system. [PLO: 1,2,3,4,10]
- The student will be better equipped to interpret Chiropractic listing systems. [PLO: 1,2,4,8,10]
- The student will build on past anatomy knowledge and get a firmer grasp of the functional anatomy of the spine. [PLO: 1,8,10]
- The student will understand and be able to articulate ideas such as springiness, stiffness, joint play and slack. [PLO: 1,4,8,10]
- The student will understand that normal biomechanical loading is necessary for spinal health. [PLO: 3,10]
- The student will appreciate that excessive loads or repetitive loads may cause damage to the spine. [PLO: 1,2,3,10]
- He or she will grasp basic arthrokinematics such as the convex/concave rule and start applying these principles in clinical courses. [PLO: 1,8,10]
- The student will have a better knowledge of common spinal conditions and how they are managed by Chiropractors. [PLO: 1,2,3,6,8,10]

Program Learning Outcomes (PLO): Students graduating with a Doctor of Chiropractic degree will be proficient in the following:

1. **ASSESSMENT AND DIAGNOSIS:** An assessment and diagnosis requires developed clinical reasoning skills. Clinical reasoning consists of data gathering and interpretation, hypothesis generation and testing, and critical evaluation of diagnostic strategies. It is a dynamic process that occurs before, during, and after the collection of data through history, physical examination, imaging, laboratory tests and case-related clinical services.
2. **MANAGEMENT PLAN:** Management involves the development, implementation and documentation of a patient care plan for positively impacting a patient's health and well-being, including specific therapeutic goals and prognoses. It may include case follow-up, referral, and/or collaborative care.
3. **HEALTH PROMOTION AND DISEASE PREVENTION:** Health promotion and disease prevention requires an understanding and application of epidemiological principles regarding the nature and identification of health issues in diverse populations and recognizes the impact of biological, chemical, behavioral, structural, psychosocial and environmental factors on general health.
4. **COMMUNICATION AND RECORD KEEPING:** Effective communication includes oral, written and nonverbal skills with appropriate sensitivity, clarity and control for a wide range of healthcare related activities, to include patient care, professional communication, health education, and record keeping and reporting.
5. **PROFESSIONAL ETHICS AND JURISPRUDENCE:** Professionals comply with the law and exhibit ethical behavior.
6. **INFORMATION AND TECHNOLOGY LITERACY:** Information literacy is a set of abilities, including the use of technology, to locate, evaluate and integrate research and other types of evidence to manage patient care.
7. **CHIROPRACTIC ADJUSTMENT/MANIPULATION:** Doctors of chiropractic employ the adjustment/manipulation to address joint and neurophysiologic dysfunction. The adjustment/manipulation is a precise procedure requiring the discrimination and identification of dysfunction, interpretation and application of clinical knowledge; and, the use of cognitive and psychomotor skills.
8. **INTERPROFESSIONAL EDUCATION:** Students have the knowledge, skills and values necessary to function as part of an inter-professional team to provide patient-centered collaborative care. Inter-professional teamwork may be demonstrated in didactic, clinical or simulated learning environments.
9. **BUSINESS:** Assessing personal skills and attributes, developing leadership skills, leveraging talents and strengths that provide an achievable expectation for graduate success. Adopting a systems-based approach to business operations. Networking with practitioners in associated fields with chiropractic, alternative medicine and allopathic medicine. Experiencing and acquiring the hard business skills required to open and operate an on-going business concern. Participating in practical, real time events that promote business building and quantifiable marketing research outcomes
10. **PHILOSOPHY:** Demonstrates an ability to incorporate a philosophically based Chiropractic paradigm in approach to patient care. Demonstrates an understanding of both traditional and contemporary Chiropractic philosophic concepts and principles. Demonstrates an understanding of the concepts of philosophy, science, and art in chiropractic principles and their importance to chiropractic practice.