Instructor's Guide to Accompany

Kinesiology in Action

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Product Overview

Kinesiology in Action is a customizable, interactive, online learning environment offering students and instructors various multimedia resources to support learning of complex concepts. Within this environment, instructors can design classes, monitor student progress, and assign quantitative and qualitative student assessment activities to students enrolled in their classes. All assignments are tracked in the platform's gradebook, which can be exported to an institution's learning management system (such as Blackboard, Angel, and CourseWorks), if desired.

Kinesiology in Action gives students an opportunity for active learning, as part of a class or independently. Many of the activities provide immediate feedback on student progress and performance. Using this format adds more value to kinesiology classes by engaging students in the participatory, information-sharing web culture to which they are accustomed. Sharing knowledge, acquiring skills and competencies is no longer limited to the classroom. Now students can independently participate in an active community of learning, deepening their understanding of kinesiology.

As an instructor, you recognize that kinesiology courses are foundations for physical therapist and physical therapist assistant students, providing them with the language of human movement and creating a bridge between the basic sciences and clinical management. Because kinesiology appears early in the curriculum, students require a straightforward approach to observing, evaluating, and understanding human movement. They must integrate anatomy, surface anatomy palpation, muscle function, alignment, kinematics, and the mechanical concepts of human movement presented in texts and lectures. Students need to examine the material frequently in their own time and at their own pace using a comfortable, accessible format. *Kinesiology in Action* will help advance these skills in the context of physical therapy patient/client management. Using recommendations from this guide, you can integrate content into lectures and create assignments to foster elements of remembering and understanding, applying and analyzing, as well as evaluating human movement.

Kinesiology in Action is available in two versions: one specific to students in physical therapist programs and one specific to students in physical therapist assistant programs. **This 'Instructor's Guide includes learning activities for physical therapist students only.**

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Appendix A: Recommended Answers to Generation Exercises

Appendix B: Palpation Practice Activities

Incorporating *Kinesiology in Action* into Your Course

Each lesson includes some or all of the following activities and features, which can be either automatically graded by the platform or submitted to instructors for qualitative feedback.

Suggestions to help you incorporate each lesson activity into your course are included. These suggestions are divided into the following categories:

- **Before class:** Activities you would like the students to complete before your classes begin.
- **During class:** Activities students will work on either independently or in small groups during your class or laboratory sessions.
- **After class:** Follow-up activities to reinforce concepts and encourage or assess retention.

Pretest

Pretests consist of 10 multiple-choice questions to gauge the 'students' pre-existing knowledge and identify areas of weakness. The intent of these activities is to prepare the students for learning by linking to the reading. These questions include foundational anatomy and kinesiology questions that address four critical components: medical terminology, review of anatomical structures, arthrology, osteokinematics, and arthrokinematics.

Suggestions for Use

BEFORE CLASS: INDEPENDENT REVIEW OR FLIPPED CLASSROOM

- Test the students' knowledge retention prior to the unit. By grading this Pretest, it ensures that students will review the readings, whether or not you chose to use this component as part of your course grade. Credit for flipped classroom participation may represent a small portion of the course grade.
- Students can be required to define or write out answers to anything that was marked as incorrect on their Pretest to ensure requisite comprehension of topics.

AT THE END OF YOUR LECTURE OR DIDACTIC COMPONENT

- Students can retake the Pretest after the lecture is completed. Doing so provides you with feedback regarding student learning immediately following presentation of the material. This also helps students to determine their own "muddiest" thinking, leading to better post-lecture review.
- Challenging concepts identified by the Pretest results can be used as discussion forum topics for students to further explore concepts or as a subsequent laboratory component.

Practice Activities

If your students take anatomy concurrently with kinesiology, these activities serve to connect the two courses and reinforce the salient structures for kinesiology. If your curriculum places anatomy and kinesiology in subsequent semesters, these activities provide you with a safeguard that students are ready for advanced learning.

Labeling

The user labels various illustrations by clicking and dragging the labels to the appropriate location. Students can be working along with their textbooks and classroom or virtual models to develop the requisite knowledge of important structures.

Hot Spot Identification

For these activities, the user is presented with an image and is prompted to click on the area identified in the clue. This activity can be used to identify specific structures and locations of injuries.

Suggestions for Use

BEFORE CLASS FOR A FLIPPED CLASSROOM ACTIVITY

- Labeling and Hot Spot Activities challenge students to identify structures important to joint movement and function. Review and assessment of knowledge prior to the class will facilitate learning as the course adds additional structural, biomechanical, and functional information.
- Bundle this activity with the Pretests for greater integration of the Chapter's information prior to class. By taking the Pretest first and then completing the related Practice Activities, students will continue to explore foundational anatomy and its application to movement.

DURING CLASS

- ***In lecture:*** Ask students to come to the front of the class and complete the activity, which can be projected to the student audience. As an add-on activity, create a PowerPoint using images from the book and lead the active learning task by asking the students to identify related anatomical structures similar to those found in the Hot Spot or Labeling Activity in the online product.
- ***In lab:*** Assign students a list of important structures, bony landmarks, muscle attachments, etc., that they must actively identify on models and skeletons.

Text Generation

For this open-ended, short-answer activity, users are given a prompt to which they respond by typing in an answer that applies the required information according to the criteria outlined in the prompt. Many of these activities include images of complex postures and movements that students are required to analyze and apply principles of kinesiology to the patient/client situation. The Text Generation Activity develops students' critical thinking about biomechanics through the integration of postures and movements found in daily living. The questions reinforce chapter materials and require students to use the information as one would in a clinical situation.

Recommended answers to these activities are provided in a separate section of this Instructor's Guide. To extend the activity, you can ask questions that integrate other regional issues, biomechanical constraints, and functional demands linked to aging, injury, and interventions.

Suggestions for Use

BEFORE CLASS FOR A FLIPPED CLASSROOM ACTIVITY

- These more challenging questions can be given before class for students to get them thinking about the application of key concepts necessary for movement function as well as rehabilitation. By showing students the expected "outcome" or level of synthesis necessary from the Chapter's readings, students can use the guided elements in the textbook, such as the "continuing exploration" boxes or "clinical examples," as building blocks. Students would not necessarily be expected to fully understand the answers to these activities before class. However, you can revisit the elements during the in-class session to develop relationships between significant principles and promote earlier understanding of the solutions.

DURING CLASS

- ***In lecture:*** Integrating these higher-order thinking questions into a lecture session is easy. Students can complete the activities in real time and the instructor can be assured that all students are participating by tracking who has submitted their answers. When courses have shorter, multiple class sessions, this activity could be incorporated at the end of the first session for "out-of-class thinking" or used in a subsequent session as an application of basic concepts from the previous session.

  The instructor can lead a discussion where the students themselves must defend the answers by citing essentials that support their decision making. Working through these linked activities may lead into further exploration of the serial installments of the case studies found within the Chapters. These activities would match high-level learning objectives found in course syllabi and also promote clinical reasoning skills aimed at patient care.
- ***In lab:*** Have students participate in small-group discussions in which one group member replicates the activity or posture mentioned in the Text Generation Activity prompt. The students can use the assignment to foster clinical reasoning by justifying their decisions based upon the scenario presented. You may also consider incorporating the image associated with the Text Generation Activity into a clinical case study to promote application of principles to the patient/client management model.

AFTER CLASS

- These activities lend themselves perfectly to out-of-class assignments. Students can view the activities and complete questions generated by the site as well as those provided by the instructor to promote learning beyond the classroom.
- Consider assigning the generation activities to the discussion board, where students post their rationales for their answer choices. Requiring all students to respond outside of class time allows the instructor to view how all students conceptualize the information and apply it to specific situations.

Critical Thinking

This activity incorporates video of a certain skill or pathology. The user answers a "decision point" question based on the video introduction. The user then views the concluding video and answers follow-up questions. This is an activity for students to visualize concepts in context and practice applying their background knowledge. The student must apply kinesiology in a patient/client situation. Students can review rationales explaining correct responses after completing the activity to receive immediate feedback.

Suggestions for Use

BEFORE CLASS: INDEPENDENT REVIEW FOR FLIPPED CLASSROOM

- Assign the reading ahead of class and ask students to review the video and complete the questions associated with the video. This pre-class assignment facilitates reading and heightens understanding prior to the class session. Review the students' results via the *Kinesiology in Action* gradebook and use this information to construct class time to meet learning needs and achieve optimal results.

- Have students go through key movements prior to class. Then play the videos at the beginning of the class to highlight key concepts explained in the textbooks. This approach allows for more class time to be spent toward higher levels of learning, such as application, analysis, and evaluation.

DURING CLASS

- ***In lecture:*** As you move through the course materials, direct students to watch the video(s) and answer the question(s). The addition of active learning within the classroom engages students and adds to topical discussions. Consider posing your own questions based upon the videos to promote understanding of different but related situations. Alternately, ask the students to view the video (s) and complete the question(s) at the end of class to obtain feedback regarding student learning immediately following presentation of the material. This end-of-session activity has the additional benefit of encouraging students to review materials outside of the classroom.
- ***In lab:*** The critical thinking activities can be assigned as small-group discussion topics to foster clinical reasoning. Have students explain the kinematics observed in the video and apply the information into clinical case studies or as part of the patient/client management model. Consider expanding this activity to incorporate the additional videos from the video library tab.

AFTER CLASS

- You may choose to assign the video to confirm students understanding of material covered during the lecture. Tracking student progress via the gradebook provides valuable information that can guide whether additional content review is needed in class at the start of the next lecture on in the context of a discussion board topic.
- Have students review the Critical Thinking Videos as well as other clips in the video library as homework to develop the students' knowledge and skills.

Posttest

Similar to the Pretests, the Posttests consist of 10 multiple-choice questions to assess understanding of key topics from the lessons. This activity reinforces learning and provides instructors with data from the online grading system to determine content areas that may need further review.

Suggestions for Use

This set of questions is good for students to do independently following the unit to self-assess their areas of strength and those areas requiring further review. They can be used in class or as homework. Review graded answers to determine student comprehension of materials to decide which concepts may need to be re-explained.

Discussion Forum

Students can access the discussion forum to view and respond to posted topics. You select the thread title and its description. You can also attach a file if required as part of the message. Students reply to the thread and activity, which you monitor and moderate. You can create group assignments within the discussion forum.

Suggestions for Use

Recommended as an out-of-class assignment, these forums allow for peer interaction and provide opportunities to develop clinical reasoning and decision-making skills beyond formal classroom sessions.

Video Library

Videos are available for students to enhance learning of key concepts. The variety of videos for each Chapter allows the instructor to develop the student's knowledge of normal and abnormal movement through visual inspection.

Suggestions for Use

The videos may be assigned as part of a flipped classroom model, whereby the in-class time serves as a discussion of the key concepts presented in the video. Alternatively, you may choose to have students view the videos during structured lecture or laboratory sessions to facilitate understanding.

Lesson Plans

The following lesson plans allow you to break down coursework into pre-class, in-class, and out-of-class activities. The flexibility of the *Kinesiology in Action* website allows you to assign some or all of the activities depending on the learning needs of your students and your course sequence.

Lesson #1: Foundational Concepts in Kinesiology

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapters 1-3)

The comprehensive foundational content in this lesson can be assigned before and while covering a unit as well as a review prior to a comprehensive final examination.

Pre-Class

ANATOMY AND PHYSIOLOGY REVIEW

- Have students review the fundamentals of biomechanics such as planes of motion (Chapter 1), connective tissue structure (Chapter 2), and muscle mechanics and force production (Chapter 3).
- The Pretest consists of 10 questions that facilitate recall of basic anatomical and physiological principles. Students will be asked to remember key concepts from the initial chapters.
- Before reading the first chapter, assign the Labeling #3 Activity asking the students to recognize the planes and axes of the body.
- In the remaining Labeling Activities, students are asked to label joint components (Labeling #1) and discriminate between various types of muscle architecture (Labeling #2 involving the arrangement of fasciculi in muscles).
- In the Hot Spot Activity, students identify the structural components of diarthrodial joints (Chapter 2).

In-Class

- Assign or re-assign the Labeling and Hot Spot Practice Activities during class. You may also provide additional active learning opportunities by using other images for labeling with guidance from the textbook and without immediate computerized feedback.
- Students can repeat the Pretest to ensure that learning has occurred.
- Following your discussion on the mechanical behavior of connective tissue and your explanation of the load deformation curve, assign Text Generation #1 to determine student comprehension of this material. You may want to have the students discuss their answers in small groups and present to the entire class (Chapter 2).
- There are two excellent videos associated with this module on active and passive insufficiency. These are very difficult concepts for students to really master. Consider presenting these two videos while you are presenting the material on active and passive insufficiency. The videos clearly demonstrate the change in basic force production with changing muscle length. **NOTE:** These clips may be reintroduced and reviewed in subsequent modules because these concepts are applied regionally.

Out-of-class

- The knowledge required to complete Text Generation #2 necessitates the student to have assimilated the arthrokinematic motion of several joints and can be assigned as a supplemental activity as a review for a comprehensive examination.
- The series of questions in Text Generation #3 can be assigned as discussion board or other types of homework after you present the material on the force-velocity relationship (Chapter 3).
- Assign the Posttest as a comprehensive assessment of learning for the unit itself.

Lesson #2: The Spine

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapter 4)

Pre-class

- Have students complete the Pretest questions before coming to class. These questions are largely anatomical review. Questions #1, 8, 9, and 10 refer to osteology. Questions #2, 4, and 5 refer to structures of the intervertebral discs. Questions #3, 6, and 7 are on basic osteokinematics.

ANATOMICAL REVIEW

- Re-examining the anatomical structures before class will be important for student comprehension of spinal movement. Have the students review the essential spinal structures.

Identification of key osseous components

- Have the students begin with the Hot Spot in which students are required to identify the following structural components of a typical vertebra: spinous process, transverse process, intervertebral disc, intervertebral foramen, vertebral body, vertebral foramen, and pedicle.
- When students are comfortable with the typical vertebral components, they can move on to the Labeling #2 Practice Activity, in which the unique bony components of the upper cervical spine are identified.

Ligaments

- Build a list of important ligaments of the spine that you would like to have the students review from their anatomy course. This can be followed by the Labeling #1 Practice Activity, which asks students to label components of the intervertebral disc.

Muscles

- Identify and have students review key global and local muscles that provide mobility and stability throughout the various spinal regions.

OSTEOKINEMATICS

- Assign the students the **Normal Lumbar Motion** video before your class on the lumbopelvic rhythm. This video clearly illustrates the specific components of spinal movement (cervical, thoracic, lumbar, and pelvic) and introduces the combined motion of the lumbopelvic rhythm.

In-class

GRAVITATIONAL MOMENTS

- At the beginning of your class presentation on the contributions of gravity to muscle contraction, have the students individually complete Text Generation #3. You can follow-up your lecture with a discussion of the students' responses. The student responses to this activity will serve as a springboard to an interesting discussion of the role of gravity in maintaining the static position seen in the figure.

LUMBOPELVIC RHYTHM AND INTEGRATION OF LUMBOPELVIC MUSCULATURE IN MOVEMENT

- Have the students review the **Normal Lumbar Motion** video from the video library. This is followed by the **Alterations to Lumbopelvic Mobility** video, which shows a subject with limited lumbar lordosis and the effect of this limitation on spinal mobility as the subject flexes forward.
- After you have discussed the role of spinal and hip extensors, have the students break into small groups and complete Text Generation #2. The diagram of EMG activity, which accompanies a photograph of the motion, nicely illustrates the change of muscle activity with the various motions. Ask the students to explain to each other the role of the biceps femoris and the erector spinae during forward flexion and extension as seen in the figures.

Out-of-class

OSTEOKINEMATICS AND ARTHROKINEMATICS

- Following your lecture on the kinematics of the spine, Text Generation #1 serves as an excellent homework assignment or quiz to assess the students' understanding of spinal movement. To answer these questions, the student must remember how flexion and extension moves and changes the shape of bony and ligamentous structures.

Lesson #3: Thoracic Cavity and Temporomandibular Joint

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapters 5 and 6)

This lesson encompasses the kinesiology of the thorax as well as the temporomandibular joint (TMJ). These topics are commonly taught separately in most curriculums. Therefore, recommendations for this lesson are separated by topic.

Pre-class

ANATOMICAL REVIEW

- Have students review the pertinent anatomical structures. Select the structures most important to your discussions of movement and ask the students to examine the location of these structures from their anatomy texts. Then, have them complete the Labeling and Hot Spot Activities.

TMJ (Labeling exercises #1, 2, and 5)

- Labeling #1 is a great quick check that asks students to correctly identify the TMJ joint capsule and suspensory ligaments. You can assign this activity just before discussing the role of these ligaments in joint mechanics.
- Labeling #2 asks that the students identify the medial and lateral pterygoid muscles, the hyoid bone, and the anterior and posterior portion of the digastric muscle. Assign this prior to your lecture on the function of the TMJ muscles in producing movements of the mouth and jaw.
- Labeling #5: Assign before your class on TMJ kinematics or as an in-class activity (see below).

Thorax (Labeling Exercises #3 and 4 and Hot Spot Activity; Pretest questions #1-6)

- Labeling #3 should be completed before you present your content on the accessory muscles of ventilation. This Labeling Activity asks that students correctly identify the following accessory muscles: Scalenes, pectoralis minor, external intercostals, rectus abdominis, internal obliques, external obliques, pectoralis major, and sternocleidomastoid.
- Labeling #4 includes the sternum, xiphoid process, central tendon, right and left crus, lateral arcuate ligament, and quadratus lumborum muscle.
- Hot Spot: This can be assigned to have students identify the manubrium, xiphoid, sternum, and right clavicle. **NOTE:** This activity may also be useful before your class on the cervical spine.
- Assign the Pretest questions before your class on ventilation. This is an excellent anatomical review of the ribs and sternum. Question #2 does ask about diaphragmatic movement and can serve to alert the students to future content.

In-class

TMJ

- It can be difficult for students to correctly link the osteokinematics and arthrokinematics of joint structures. This is especially true in the TMJ, given the unique features of the joint.
- Assign Labeling #5 to be quickly completed in class. This Labeling Activity asks students to identify the specific structures within the TMJ (superior joint space, mandibular fossa, mandibular condyle, articular disc, articular eminence, and inferior joint space), which students must know before you can present kinematics of opening and closing. You can follow this up with a discussion of the joint mechanics of opening and closing.

- Have the students watch the **TMJ Normal Motions** video from the video library as an adjunct to you class discussion. This video demonstrates normal joint motion and clearly explains the arthrokinematic movements that correspond to the osteokinematics. Have the students look at a partner and see if they can discover any deviations from the normal osteokinematic movements of opening and closing. If they find anything other than proper mechanics, ask them to think of what could be causing the mechanical deviation.
- Review Pretest questions #7 through 10, which require students to understand kinematics and movement production at the TMJ. Alternatively, you can have the students break up into small groups and explain the rationale for each answer and then follow their in-group discussion with a quick presentation to the entire class.
- Following your presentation of the TMJ, use all three Text Generation questions as a small-group activity to reinforce the concepts presented. The students can explain to each other the rationale for the correct answer. This approach often helps the students to recognize which aspects of the material are still not completely clear to them. Having a classmate explain can benefit both students in the learning process.

THORACIC CAVITY

- The Critical Thinking Activity appropriately links posture and breathing. If you have already covered posture in your course, this is an excellent opportunity to link proper alignment to such an important function as breathing. The first 20 seconds of the video can also be used in your unit on posture of the trunk. Have all the students watch the first 20 seconds of the video in which proper alignment in sitting is illustrated. As an in-class demonstration, have the students break into small groups. Ask the students to examine each other's sitting posture and note any deviations. Lead the discussion on the most frequently seen postural abnormalities.
- Watch the second half of the video. Ask the students to assume a kyphotic posture and discuss any changes in their breathing pattern. Lead a discussion on the effect of posture on breathing. Have the students watch the second video in which the impaired individual corrects their posture and discuss. Add in your own case studies on the effects of postural abnormalities on the mechanics of ventilation.

Out-of-class

TMJ

- Have students review Pretest questions #7 through 10 if not already done in class.
- As an exercise in supporting your answers with evidence, have students take the Posttest for homework. Then, ask the students to write a few sentences of explanation for each question's correct response and provide information from the text material to corroborate their response. Have students e-mail their responses or consider posting this activity as a discussion board topic.

THORACIC CAVITY

- Following your classroom discussion of the muscle forces involved in breathing, have the students complete the Labeling #3 Activity. Add to this a homework assignment in which you ask the students to indicate each muscle's function in ventilation.
- Have the students complete the Critical Thinking Activities as a check on their comprehension of the material you presented on posture and breathing.

Lesson #4: The Shoulder Complex

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapter 7)

Pre-class

ANATOMICAL REVIEW

- Before class, have students review the shoulder anatomical structures pertinent to the kinesiology of this region.

Identification of key osseous components

- Assign general or specific landmarks and key features of the three bony partners:
    - Scapula
    - Clavicle
    - Humerus

Ligaments

- Create a listing of pertinent structures as outlined in the chapter. Examples from the Levangie and Norkin text include:
    - Coracoclavicular ligament
    - Anterior and posterior sternoclavicular ligaments
    - Costoclavicular ligament
    - Coracohumeral ligament
    - Superior, middle, and inferior glenohumeral ligaments

Muscles

- Identify key muscles that produce force through the region. These can be in groups based on action (e.g., flexors) or individual (e. g., pectoralis major)

OSTEOKINEMATICS

- Have students review gross shoulder movements in all three planes: flexion; extension; abduction, adduction, internal rotation, external rotation

OTHER TOPICS AND ASSIGNMENTS

- Have students preview the videos in the video library (shoulder evaluation, shoulder assessment, and shoulder biomechanics) to understand the relationships between the three bony components. These videos will reinforce the flipped classroom learning assignments found above.
- Students can also be assigned the Labeling and Hot Spot Activities under the Practice tab. The Labeling Activity requires students to identify the motions of the scapula. The Hot Spot Activity requires students to identify correctly the soft tissues around the glenoid fossa.
- Ask the students to complete the Pretest portion of the shoulder module before coming to class. Students should come to class with a list of questions they missed for further review.
- Prior to class, review the students' performance on the Pretest.
- Consider posting a discussion board topic that allows students to post questions about the material.

In-class

- Assign or reassign the Labeling and Hot Spot Practice Activities during class. You may also provide additional active learning opportunities by using other images for labeling with guidance from the textbook and without immediate computerized feedback.
- Students can also repeat the Pretest to ensure that learning has occurred. If using the Levangie and Norkin text, consider using Figure 7-13: Scapular Tipping, Figure 7-16: Upward Rotation, and Figure 7-19: Protraction and Retraction of the Scapula.
- For the kinematic portion of your lecture, have students watch the Critical Thinking videos **Shoulder Assessment: Glenohumeral Joint** and **Shoulder Biomechanics** in class as a basis for class or small-group discussion.
    - Shoulder Assessment: Glenohumeral Joint explains the importance of external rotation with elevation.
    - Shoulder Biomechanics reinforces the multijoint movement consistent with shoulder flexion.

  Incorporating the kinematic videos in class reinforces the students' understanding of movement. Students can record their responses to the kinematic questions for faculty review.

- After covering the kinematic Video Clips, advance the students' knowledge by showing the videos of shoulder pathology. These include the Scapular Instability and Adhesive Capsulitis clips. If time does not allow for use of these clips in class, assign them for out-of-class study.
- For additional active learning, students in small groups can be assigned to complete the Posttest. In addition, each group must be able to explain/defend why their answer is correct. This critical reasoning is important for reinforcement of learning about normal and abnormal movements. As an alternative, this can also be an assignment outside of class, with student groups submitting their respective answers.

Out-of-class

- Assign the Text Generation Activities. These applied scenarios continue to explore the application of kinesiology to human motion.

Lesson #5: The Elbow and Forearm Complex

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapter 8)

Pre-class

ANATOMICAL REVIEW

- Before class, have students review the anatomical structures of the elbow and forearm that are pertinent to the kinesiology of this region.

Bony structures

- Assign the Hot Spot Activity as an independent pre-class activity. It is an excellent review of the osseus components, with specific attention to bony landmarks important for understanding elbow movement. The students are asked to identify the following structures: medial epicondyle, capitulum, olecranon fossa, lateral epicondyle, radial head, trochlear notch, and olecranon process.
- Pretest Question #1

Musculature

- Labeling Activities #1 and #2 require accurate identification of the elbow and forearm musculature. The student must correctly label the muscles that attach to the lateral epicondyle and the medial epicondyle.
- You may also wish to have the student review the relevant shoulder biarticular muscles crossing the elbow.
- Pretest Questions #3, 6, 8, and 9 apply to this topic.

OSTEOKINEMATICS

- Assign the Video Clip **Normal Elbow Motion**, which explains normal motion for common functional tasks. Have the student review the basic movements of the elbow (flexion and extension) and of the forearm (pronation and supination). You can also assign Pretest questions #5, 7, 8, and 10 as part of the review process.
- To preview the length-tension relationship of the biceps before class, have the students watch the first 28 seconds of the video **Elbow Range of Motion: Passive Tension of Triceps With Shoulder Positioning** in the video library (also found in the Critical Thinking #1 exercise) to familiarize themselves with how the length-tension relationship is applied for the biceps.
- Assign the Video Clip **Elbow Strength: Biceps Strength With Shoulder Positioning: Active vs. Passive Insufficiency** (also found in the Critical Thinking #2 exercise).

In-class

OSTEOKINEMATICS

- Students frequently have difficulty placing individual joint movements in the context of the entire kinetic chain. Following the osteokinematic portion of your lecture, show the **Elbow Limitations and Compensations** video to the class. This video nicely demonstrates compensatory movements of the joints proximal and distal to the elbow, which are used in normal activities of daily living.

ARTHROKINEMATICS

- Pretest questions #2 and 4 cover this topic.

MUSCLE LENGTH-TENSION RELATIONSHIP

- Following your presentation of the relationship of biceps and triceps length to elbow range of motion, have the students watch the video **Elbow Range of Motion: Passive Tension of Triceps With Shoulder Positioning.** This video describes the role of the biceps and triceps in open chain elbow flexion with the forearm in supination. You can use this video as a starting point for a discussion of how changing the position of biarticulate muscles affects joint motion. Be sure to clarify that the positions in the video are used for demonstrating these concepts only. Emphasize that it is inappropriate to measure range in standing. Use the questions in Critical Thinking #1 immediately following your lecture/discussion to assess the level of student comprehension of this concept.

ACTIVE AND PASSIVE INSUFFICIENCY

- The movement analysis in Text Generation #1 is an excellent precursor to your discussion on active and passive insufficiency, which corresponds to the reading on the biarticular elbow flexors and extensors.
- Incorporate the Critical Thinking #2 video **Elbow Strength: Biceps Strength With Shoulder Positioning: Active vs. Passive Insufficiency** into your lecture discussion of how strength is altered by changing the length of the biarticulate portions of the biceps and triceps. Have the students answer the three questions here. You can use these questions as a follow-up to your lecture to determine comprehension of this material. You can use these questions as a small-group activity in which the students must explain the rationale for their answers to the group. **NOTE:** The subject is tested in standing. Students must be reminded that the standing position is only for demonstration purposes and strength would not be assessed in standing. You may also wish to clarify that the terms "slack" and "stretch" are no longer used and refer to the elongated and shortened positions of these muscles, respectively.
- Have students complete Text Generation #2, **Open vs. Closed Kinetic Chain**.
- Assign a small-group activity in which students incorporate bone models to explain and demonstrate their answers.
- In a traditional lecture setting, consider embedding Critical Thinking videos #1 and 2 into your PowerPoint. In a flipped classroom, use these clips after students have read about elbow flexors to help clarify these muscle relationships.

Out-of-class

ACTIVE AND PASSIVE INSUFFICIENCY

- Following the lecture on biarticular elbow flexors and extensors, have students complete Text Generation #1. Movement analysis can be evaluative of student performance by grading or as an assessment of retention from lecture.

ARTHROKINEMATICS

- Following the lecture presentation on elbow arthrokinematics, assign the Hot Spot questions to determine material retention.
- Assign Text Generation #2, Open vs. Closed Kinetic Chain, which can be used for:
    - Independent student review of salient points

- Assessment (graded or non-graded) to identify areas where student comprehension is lacking

Lesson #6: The Wrist and Hand Complex

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapter 9)

Pre-class

ANATOMICAL REVIEW

Before assigning *Kinesiology in Action* activities, ensure students review the wrist and hand anatomical structures pertinent to the kinesiology of this region. For example:

Key osseous components

Assign general or specific landmarks and key features of the major joint regions found in this chapter, including:

- Radiocarpal joints (including the distal radioulnar joint) and midcarpal regions of the wrist
    - Distal radial and ulnar regions
    - Proximal carpals
    - Distal carpals
    - Carpal tunnel
- The Hand Complex of the fingers and thumb
    - Metacarpals
    - Phalanges

Ligaments

- Create a listing of pertinent structures as outlined in the associated book chapter (e.g., Concept Cornerstone #9-2). Encourage students to focus on figures that highlight structures:
    - Within the wrist: triangular fibrocartilage complex at the radioulnar; volar and dorsal ligaments of the wrist; the transverse carpal ligament
    - Within the hand: the volar plate; the deep metacarpals; the sagittal bands; the interphalangeal joints; and the extensor hood mechanism

Muscles

- Have students identify key muscles that produce force through the region. These can be in groups based on action (such as flexors), region (such as thenar), or individual (such as flexor digitorum profundus).
- Special considerations: You can assign students to review special relationships important to wrist and hand function. Examples include the carpal tunnel, the palmar arch, the anti-deformity position of the hand, and tenodesis.

OSTEOKINEMATICS

- Have students review gross wrist and hand movements in all planes: flexion, extension, abduction (radial deviation), adduction (ulnar deviation), and opposition/reposition of the thumb

OTHER TOPICS AND ASSIGNMENTS

- Have students preview the following palpation tutorial videos in the video library to help them understand the relative relationships between the many bony components: **Palpation Tutorial: Wrist and Palpation Tutorial: Carpal Bones of the Wrist**.

- As an introduction to hand function, assign the three gripping videos **(Gripping Tasks Power, Gripping Tasks Precision, and Gripping With Rheumatoid Arthritis)** and have students compare the differences in gripping.
- Assign the Labeling and Hot Spot Activities. The Labeling Activity requires students to identify the structures found in the distal anterior forearm. The Hot Spot Activity requires students to identify correctly the bones on a radiograph that comprise the wrist joints.
- Ask the students to complete the Pretest before coming to class. Students can note which questions they missed.
- Prior to class, review the students' performance on the quiz. Consider creating a discussion board topic to which students can post questions about the material.

In-class

- Students can be assigned or reassigned the Labeling and Hot Spot Practice Activities during class. You may also provide additional active learning opportunities by using other images for Labeling with guidance from the textbook and without immediate computerized feedback. Students can also repeat the Pretest to ensure that learning has occurred.
- For the kinematic portion of your lecture, have students watch the Critical Thinking Videos **Active/Passive Insufficiency vs. Functional Position of the Hand and Tenodesis.** Allow these clips to become the basis for discussion for the class or in small groups.
    - **Active/Passive Insufficiency vs. Functional Position of the Hand:** Ask students to review the video that places a person's hand into the optimal functional position of wrist extension with finger flexion. The video includes an overlay of joint angles that will help students visually confirm the points in the range of motion of the wrist, MCP, and PIP joints. The video continues with the therapist recording a dynamometric measure of finger flexion. The questions linked with this video help the students to relate critically the concepts of optimal positioning to force production in terms of active and passive insufficiency that occurs in the flexor and extensor muscles. These Critical Thinking questions reinforce the concepts of force production within the hands, based upon wrist flexion. The use of a dynamometer can easily be incorporated into a class-based or small-group activity to reinforce concepts.
    - **Tenodesis:** This comprehensive video helps students understand the optimal hand position and how it moves. The initial part of the video guides the students' learning about positioning and hand closure using a pad-to-pad strategy. The healthy individual demonstrates active movement at the wrist and its effect on finger motion due to the tension in the tendons of the long finger flexors. Students can perform this on themselves as well as on classmates. The questions challenge students to consider the tenodesis grip and the muscles that provide finger closure when innervation is not present, such as in the presence of a C5 injury. As the clip continues, the students have the opportunity to observe muscle atrophy within the wrist and hand regions of an individual diagnosed with C5 tetraplegia for over 10 years. Images of this patient's movements confirm how wrist extension alone can increase function by use of the tenodesis grip. The video continues for review of additional grasping techniques. Through the use of the thumb, students can visualize how a pincer grasp can augment the tenodesis grasp for individuals with spinal cord injury. After reviewing the entire clip

with the class, lead a discussion that reaffirms the key principles of normal hand closure and gripping, as well as how tenodesis utilizes principles of the length-tension relationship.

- Assign students into small groups to complete the two Text Generation Activities. These two exercises have students exploring concepts relating to wrist positioning. The first asks students to confirm tension generated while gripping a blood pressure cuff held in various positions of sagittal plane wrist motion. The second activity addresses the arthrokinematic motion needed to restore normal osteokinematic motion following a fracture.
- Assign students into small groups to complete the Posttest for further exploration of content. Require each group to explain/defend why their answer is correct. This critical reasoning is important for reinforcement of learning about normal and abnormal movements and the interventions administered. As an alternative, this can also be an assignment outside of class, with student groups submitting their respective answers.

Out-of-class

- If not used in class, assign the Text Generation Activities, which are applied scenarios that continue to explore the application of kinesiology to human motion.
- If not used during scheduled class time (lecture or lab), additional videos in the video library can be assigned to ensure students understand gripping strategies under normal conditions and in the presence of disease (rheumatoid arthritis).

Lesson #7: The Hip and Pelvis Complex

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapter 10)

Pre-class

ANATOMICAL REVIEW

- Before class, have students review the pelvis and femur as well as the lumbar spine.

Identification of key osseous components

- Assign general or specific landmarks and key features of the three bones that fuse to form each of the two innominates and the femur in this chapter. The instructor's assignment can emphasize the congruence between the femoral head and the acetabulum that provides greater stability than that of the glenohumeral joint (a similar ball-and-socket synovial joint).

Ligaments and fibrous capsule

- Create a list of pertinent structures as outlined in the chapter. Images from the text to be reviewed should include anterior and posterior views of the hip joint.
- Help students appreciate the mechanisms relating to the frequent injury of the ACL. The Y ligament structure and function should be emphasized because this is a critical element for the posture and gait module.

Muscles

- Identify key muscles that participate in the triplanar motions of the hip as well as those that control the pelvic motions. Emphasize open vs. closed chain movement.

Terminology

- Create a list of common terms regarding the unique structural angulations and alignments in the frontal planes and transverse planes. Students should identify variations within the femur that may affect limb position and function, such as coxa valga and vara as well as femoral retroversion and anteversion.

Special considerations

- Assign readings for students to review special coupled movements between the lumbar spine, pelvis, and hip. You may choose to introduce the concepts of top-down motor control, where the muscles at the hip influence the femur's position at the knee, as in genu valga.

OSTEOKINEMATICS

- Have students review the anatomical planes and axes of motion for the lumbar, pelvic, and femoral areas in both open and closed kinetic chains. For example, have them consider how hip abduction/adduction occur as the femur moves on a fixed pelvis and as the pelvis moves on a fixed femur.

OTHER TOPICS AND ASSIGNMENTS

- Assign the Labeling and Hot Spot Activities. The Labeling Activity requires students to identify structures consistent with an anterior view of the lower spine and hip joint. The Hot Spot

Activity requires students to identify seven structures as they view the anterior and posterior hip joint.

- Ask the students to complete the Pretest portion of the module before coming to class. The questions highlight key features of the region: innominate composition, pelvic articulations, shape of femoral articular surface, muscle attachments and actions, ligaments, osteokinematic movements, and line of gravity (LOG) changes with movement. Students can note which questions they missed.
- Prior to class, review the students' performance on the quiz. Consider creating a discussion board topic to which students can post questions about the material.
- Have students preview the videos in the video library.
    - **Hip Motion Normal** identifies pelvic and hip movements in standing. Visual cues are provided to facilitate student learning. After viewing, students should be able to explain anterior and posterior pelvic tilting in the sagittal plane and hip abduction as well as pelvic dropping in the frontal plane.
    - **Single Limb Stance With Hip Weakness** will help students to visualize the interaction of weight-bearing and pelvic position during functional activities. During this video, students can observe changes in pelvic and trunk positions when the subject with muscle weakness attempts to perform hip flexion on each side. Consider creating a series of questions that assist students in identifying the compensated movements to address weaknesses of the stance limb as well as the flexed limb. This type of activity allows students to consider both the open and closed chain movements of the region. Subsequently, the instructor can then review the students' postings from a learning management system discussion board or answers to a flipped classroom assignment when presenting lecture content and when introducing the Critical Thinking Activity **Hip Assessment: Stability Control** for this lesson.
    - Videos #7 through 9: **Palpation Tutorials: Hip in Prone, Hip in Side-lying,** and **Hip in Supine.** These clips orient students to key anatomical landmarks, muscles, and their relationships to each other and allows for practice outside of class. Alternately, you can integrate these clips during a laboratory portion of class.

In-class

- Students can be assigned or reassigned the Labeling and Hot Spot Practice Activities during class. You may also provide additional active learning opportunities by using other images for labeling with guidance from the textbook and without immediate computerized feedback. Students can also repeat the Pretest to ensure that learning has occurred.
- For the osteokinematic and arthrokinematic portion of your lecture, assign Text Generation #4 to facilitate understanding of normal arthrokinematic function at the hip joint by describing the surfaces of each articular partner and then identifying the appropriate arthrokinematic motions during open chain flexion. Text Generation #1 will help assess the students' understanding of the convex-concave rule within the hip. **NOTE:** The second bullet of this activity asks students to identify which muscles generate the force to provide the osteokinematic motion during open chain flexion. You may choose to have students answer one of these at a time, or both, depending on the content delivery during lecture. Further exploration of the required

arthrokinematic movements during other femoral or pelvic motions (i.e., open or closed chain) can also be added.

- To help students link muscle action to functional movements, assign Text Generation #3. This activity challenges students to answer three questions relating the concepts of passive insufficiency to an image of a person standing and performing a hamstring stretch with 90 degrees of hip flexion.
- Text Generation #2 provides students with the opportunity to consider the coupled motions of the spine and pelvis during hip abduction. It also asks students to identify the class of lever shown during the activity. Use this portion of the activity to assess whether students can apply concepts regarding lever systems from Lesson #1.
- Text Generation #1 quizzes students' ability to apply key kinesiology principles to the functional activity of the squat. You may choose for students to first view Video #2, **Hip Motion With Squat,** from the video library and have a focused discussion about the squatting task before completing this activity. In the activity, students are first asked to consider the muscles involved and the type of contraction needed to perform the task. The latter two questions assist students in their critical thinking about how hip muscle actions and hip joint positions influence knee positions and forces. This set of questions provides a means of enhancing understanding of closed chain movement and the coupled motions that occur throughout the limb during a squat.
- The Critical Thinking Videos can be assigned within the class for discussion or as out-of-class assignments for review in subsequent sessions.
    - **Hip Assessment: Stability Control** provides an opportunity for students to consider the role of the hip musculature during the closed chain task of single-leg stance and the kinematic motions consistent with pelvic dropping and Trendelenburg. In the first portions of the video, an image appears as a thumbnail in the left upper corner of the screen to provide students with the conceptual basis for the osteokinematic movement. The instructor can replicate the exercise using circles placed on the ASIS to demonstrate how the pelvis drops on the side opposite the stance leg. (**NOTE:** The instructor may choose to assign Question #1 of this learning activity here or wait to present all three questions at the end.) The subsequent portion of the video provides a visual of an EMG unit's output of the hip abductor muscle activity during single-leg stance and the influence of a compensatory lateral trunk lean to reduce muscle activity. Similarly, the instructor can replicate this in class or as a lab activity. The questions relating to this critical thinking assignment allows students to problem solve about compensations for a pelvic drop, the muscles that contract, and the application of a cane. The instructor can assign these and then review to ensure understanding of key principles.
    - **Hip Assessment: Hip-Pelvis Kinematics** introduces the relationship of pelvic and hip mobility to gait and step length. The students are presented with a short clip and listen to the concepts of reduced step length prior to being presented with a questions about the requisite pelvic motion needed for an optimal step. The video resumes with a thumbnail image in the upper right corner to aid the students' understanding of the hip and pelvic rotations needed during stepping. The two subsequent questions query students to consider hip osteokinematic motions during single-leg stance and with trunk rotation. Instructors can review the answers with the students as well as provide additional functional scenarios.

- Assign students into small groups to complete the Posttest for further exploration of content. Require each group to explain/defend why their answer is correct. This critical reasoning is important for reinforcement of learning about normal and abnormal movements and the interventions administered. As an alternative, this can also be an assignment outside of class, with student groups submitting their respective answers.

Out-of-class

- In addition to the videos previously noted, consider assigning other clips in the video library to facilitate applying kinesiology to functional tasks. Video #3: **Sit-to-Stand With Hip Weakness** illustrates how adaptions allow an individual with hip muscle weakness to rise from a chair. Consider assigning a series of questions to promote student understanding of movement in general, such as the biomechanical principles of center of mass and base of support needed to successfully complete the task and the muscular forces needed to complete the task. Also consider creating active learning scenarios for students to explore how they would adapt the task given either muscle or joint impairments.

Lesson #8: The Knee

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapter 11)

Pre-class

ANATOMICAL REVIEW

Before class, have students review the distal portion of the lower extremity anatomical structures pertinent to the kinesiology of this region.

Key osseous components

- Assign general or specific landmarks and key features of the two major joint regions, tibiofemoral and patellofemoral, in this chapter. Emphasize the incongruence between the femoral and tibial condyles as well as the differences in articular surfaces medially and laterally on the femur and tibia.

Ligaments and the fibrous capsule

- Create a listing of pertinent structures for students to review. If using the Levangie and Norkin text, consider having students review the figures from the text, including both joints at the knee. Using Case Application #11-2 will help students appreciate mechanisms relating to the frequent injury of the ACL.

Muscles

- Identify key muscles that participate in the flexor and extensor groups that produce force through the region for students to review.

Terminology

- Create a list of common terms regarding alignment in the sagittal and frontal planes.

Special considerations

- Instructors should assign readings to review special relationships important to each of the two joints. Examples include tibiofemoral alignment (genu varus and valgus), weight-bearing forces on knee structures, the locking and unlocking mechanism of the knee, and stabilization of both joints.

OSTEOKINEMATICS

- Have students review the anatomical planes and axes of motion for tibiofemoral and patellofemoral movements in kinetic chains. Have them consider how flexion/extension and rotation occur as the tibia moves on a fixed femur and as the femur moves on a fixed tibia.

OTHER TOPICS AND ASSIGNMENTS

- Assign the Labeling Activity from *Kinesiology in Action*. The Labeling Activity requires students to identify structures consistent with an anterior view of the knee joint.
- Assign the Hot Spot Activity, which requires students to identify six structures as they view the tibial plateau.
- Ask the students to complete the pretest before coming to class. The questions highlight key anatomical structures (such as shape of menisci, patellar attachments), relationships of structures (Q angle), and biomechanics (center of gravity during squatting). Students can note

which questions they missed. Review the students' performances via the gradebook. Consider creating a discussion board topic to which students can post questions about the material.

- Have students preview the videos in the video library.
    - Using the **Double-and Single-Limb Stance and Squat** clip will help students to visualize the interaction of weight-bearing and knee position during functional activities. During the first 16 seconds, the students can observe knee position when the subject is in double-limb stance. Advancing this video for another 16 seconds will guide students in visually determining how knee alignment can change when an individual is in single-leg stance. The video can be paused here for students to practice this on each other to better appreciate the subtle differences as one's weight shifts into single-leg stance. Advancing the video further allows students to picture how the knee must move as one lowers into and raises from a squat. A side view is added for students to consider optimal posture and alignment during this functional activity.
    - The Palpation video for the knee provides students a review of the relevant structures and allows for palpation practice outside of class.

In-class

- Students can be assigned or reassigned the Labeling and Hot Spot Practice Activities during class. You may also provide additional active learning opportunities by using other images for labeling with guidance from the textbook and without immediate computerized feedback.
- Students can repeat the Pretest to ensure that learning has occurred. Alternatively, select specific questions to ask the class as the relevant material is presented. Doing so will verify that students have the requisite foundational knowledge of the anatomical structures prior to applying principles of kinesiology throughout the region.
- For the arthrokinematic portion for your lecture, students can be assigned completion of the Text Generation Activities to facilitate understanding of restoring normal arthrokinematic function at the tibiofemoral joint. Text Generation #1 will help instructors to assess the students' understanding of the role of mobilizing tibia on femur and femur on tibia to increase knee flexion after an injury. Have students practice performing the arthrokinematic motions and review their performances. Also, consider flipping the question to ask how the students would mobilize the knee to increase extension in the presence of a different injury.
- Present the **Weakness or Limitation of Joint Consistent With Knee Pathology (ACL)** clip from the video library during the lecture as you discuss the role of the ACL. This video features a patient who underwent ACL reconstruction surgery 7 weeks prior. For an active learning segment, students can be assigned guided questions that ask them to identify changes in the activity as a result of the knee injury. Students can discuss issues of weight-bearing, foot positioning, and function of the knee.
- Have students complete the Critical Thinking Activity **Knee Assessment: Joint Interaction With the Knee** or present it as a guided activity. This video-based activity provides the opportunity for students to consider inter-joint (knee and ankle) kinematics during standing and the influence of tight musculature on posture. Consider replicating the exercise in class using elastic bands to demonstrate how tight plantar flexors may cause genu recurvatum and how quadriceps muscle weakness (inability to shorten and generate adequate force) can lead to extensor lag.

- Have students complete the Critical Thinking Activity **Knee Assessment: Patellar Motion.** This video-based activity introduces the relationship of patellar mobility to tibiofemoral motion. Using a case scenario, the therapist in the clip notes that a patient reports increased pain and decreased squatting ability in single-leg stance (first 13 seconds of clip). Consider pausing the clip here to review with the class the interdependence of these two joints and their contributions to range of motion. Prior to advancing the video, ask the class to identify interventions that may be helpful to increase function and reduce pain. Returning to the clip, the students will see the therapist facilitate normal patellar tracking to reduce symptoms. Consider pausing the clip here to query students on their knowledge of patellar tracking and the related arthrokinematic movements during knee flexion. After discussion is complete, ask what other biomechanical issues are noted. Once again, return to the video to present ways to address the additional problems of genu valgus and an increased Q angle. Afterward, summarize the clinical reasoning steps used to determine biomechanical dysfunction in persons with patellofemoral pain for the students.
- For additional active learning, students in small groups can be assigned to complete the posttest for further exploration of content. In addition, each group must be able to explain/defend why their answers are correct. This critical reasoning is important for reinforcement of learning about normal knee mechanics and altered movement in the presence of injury. As an alternative, the posttest can be an assignment outside of class, with student groups submitting their respective answers.

Out-of-class

- Using the Critical Thinking Videos and video library as models, create related case studies that allow the students to apply key principles into clinical care. Consider creating an assignment with focused questions that ask students to determine altered biomechanics in the presence of a posterior cruciate ligament or medial collateral ligament injury. Another option is to ask the students to outline their thoughts on the influences of weight-bearing on the mechanics of the knee and how this also affects a physical therapist's exercise prescription.

Lesson #9: The Ankle and Foot Complex

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapter 12)

Pre-class

ANATOMICAL REVIEW

- Have students review the distal portion of the lower extremity anatomical structures (from the knee joint to the phalanges) pertinent to the kinesiology of this region. There are 28 bones in the region, and this can be an important step for advanced learning

Key osseous components

- Assign general or specific landmarks and key features of the major joint regions found in this chapter. These include the talocrural joint as well as the proximal and distal tibiofibular joint that determine motion and function at the ankle joint proper.
- Students should also review bony relationships in each of the three sections of the foot:
    - The hindfoot
    - The midfoot
    - The rearfoot

Ligaments

- Create a listing of pertinent structures as outlined in the chapter to help students appreciate mechanisms relating to the frequent injury of the lateral ankle ligamentous structures. Images from the text to be reviewed should include those relating to the ankle and hindfoot and midfoot.

Muscles

- Identify for students key muscles that produce force through the region. These can be in groups based on action (such as toe extensors and ankle dorsiflexors), on origin (such as extrinsic muscles and how they cross relative to the malleoli), or individual muscles (such as flexor hallux longus and tibialis posterior).

Terminology

- Have students review movements within the ankle and foot. Having universal definitions of dorsiflexion and plantar flexion as well as inversion/eversion and pronation/supination is critical to understanding foot movements.

Special considerations

- Assign readings for students to review special relationships important to wrist and hand function. Examples include the tarsal tunnel, the subtalar neutral position, the longitudinal arches, and common deformities (such as flatfoot and hallux valgus).

OSTEOKINEMATICS

- Have students review the anatomical planes and axes of motion for movements in all planes within the ankle and foot in an open kinetic chain. Have them consider how plantar flexion (flexion) and dorsiflexion (extension), abduction and adduction, and rotation occur throughout

the region. Ask students about the coupled motions of pronation and supination and where these movements occur within the foot.

OTHER TOPICS AND ASSIGNMENTS

- Have students preview the videos in the video library
    - The **Normal Motion of Foot and Ankle in Stance** clip helps students understand the relationship of weight-bearing to foot position. This video will guide students in visually determining calcaneal inversion and eversion as well as supination and pronation in a static-stance position.
    - The two palpation videos (**Lateral Border of the Foot** and **Medial Border of the Foot**) provide students a review of the relevant structures. Suggest that they practice these techniques outside of class.
- Assign the two Labeling Activities, which require students to identify the structures on the lateral and medial aspects of the ankle and foot.
- Assign the Hot Spot Activity, which requires students to identify eight structures and axes within the region.
- Ask the students to complete the Pretest portion before coming to class. Students should come to class with a list of questions they missed for further review.
- Prior to class, review the students' performance on the Pretest.
- Consider posting a discussion board topic that allows students to post questions about the material.

In-class

- Students can be assigned, or reassigned, the Labeling and Hot Spot Practice Activities during class. You may also provide additional active learning opportunities by using other images for labeling with guidance from the textbook and without immediate computerized feedback.
- Students can repeat the Pretest to ensure that learning has occurred. Alternatively, select specific questions to ask the class as the relevant material is presented. Doing so will verify that students have the requisite foundational knowledge of the anatomical structures prior to applying principles of kinesiology throughout the region.
- For the arthrokinematic portion for your lecture, students can be assigned completion of the Text Generation Activities to facilitate understanding of ligamentous function within the region. Text Generation#1 will help you assess the students' understanding of the role of each ligament on resisting stresses on the lateral aspect of the ankle and foot. Review the students' performance while they practice palpating and performing the osteokinematic motions in class.
- After an introduction of the arthrokinematic motion at the ankle, consider assigning Text Generation #2. This activity allows the students to apply the concepts of restoring the proper arthrokinematic motion following an Achilles tendon injury.
- For additional active learning, students in small groups can be assigned the Posttest. Ensure that each group can explain/defend why their answers are correct. This critical reasoning is important for reinforcement of learning about normal and abnormal relationships between segments within the foot (such as components of the first ray and hallux valgus), movements of the region in both open and closed chain conditions (closed kinematic chain [CKC] pronation and supination twist), and the function of key structures in the presence of injury. As an alternative,

this can also be an assignment outside of class, with student groups submitting their respective answers.

Out-of-class

- The Critical Thinking Video **Subtalar Closed-Chain Pronation and the Effects on the Knee** as well as the video library clips **Normal Motion of the Foot and Ankle With Sit-to-Stand/Step-ups** and **Functional Tasks With Ankle Limitations** can be assigned for discussion in subsequent classes or labs about ankle and foot kinematics during activities of daily living. These videos introduce how pathology within the region can impact functional ability.
    - **Normal Motion of the Foot and Ankle With Sit-to-Stand/Step-ups:** Ask students to review this video, which illustrates an individual getting out of a chair and going up a step. The video provides the students with details on the amount of range of motion needed in dorsiflexion and plantar flexion to perform these two common daily tasks. Consider creating patient cases in which students can view examination data to determine whether function would be impaired. If impaired, what osteokinematic and arthrokinematic movements need to be addressed to maximize function?
    - **Functional Tasks With Ankle Limitations:** Advance the above activity with this video, which addresses the concepts of joint impairments (patient has a right trimalleolar fracture) and how altered kinematic motions change one's ability to perform the step-up and-down.
    - **Subtalar Closed-Chain Pronation and the Effects on the Knee:** This comprehensive video helps students to relate the movements of the ankle and foot in conjunction with the knee joint while performing a squat. By assigning it from the video library (as opposed to using it as the self-graded Critical Thinking Activity), you can post questions about it on the discussion board. For example, you can direct students to pause the video periodically to measure learning. The initial part of the video guides the students' learning about standing posture and lower limb positioning. Students can be asked to determine all movements occurring in the lower extremity joints, or even just at the subtalar joint, to reinforce the movements outlined in the text. As the video advances, the subject performs a squat, resulting in a significant increase in pronation at the foot. By continuing the video, the students can listen as the therapist explains how the coordinated lower extremity joints' activity influences the foot's overpronation, such as when an individual exhibits genu valgus. Consider flipping the scenario and asking the students to identify the compensatory movements that occur when the foot supinates excessively during a squat or how genu varus influences foot position. The last portion of the video provides the students with an image of a runner on the treadmill. This posterior view helps students visualize the concepts of pronation and supination in the weight-bearing foot as a subject lands repeatedly on the treadmill. The instructor can post a question to the students to compare rearfoot motion during running with the subject's standing static posture.
- Alternately, assign the **Subtalar Closed-Chain Pronation and the Effects on the Knee** video as the self-graded Critical Thinking Activity. The video is accompanied by three questions that access students' abilities to analyze the impact of overpronation on related lower extremity structures, especially at the knee. For the first question, students are asked to identify possible

lower extremity muscular compensations in the presence of overpronation. For the next two questions, the students consider how the forces from excessive pronation can overstrain ligaments at the knee when excessive internal rotation and excessive genu valgus occur. After reviewing the responses from the class either in a subsequent class or lab or on the discussion board, you can foster the clinical reasoning processes necessary to apply how changes in posture and alignment within the closed kinematic chain influence tissue stresses that may lead to injury or dysfunction.

Module #10: Integrated Function: Posture and Walking

(Corresponds with Levangie and Norkin: *Joint Structure and Function,* Chapters 13 and 14)

NOTE: Because this lesson integrates information essential to two important clinical skills, postural and gait assessment, the recommendations for use of Kinesiology in Action will assume that instructors will hold multiple classes on the two topics. As such, many of the suggestions for the pre-class, in-class and out-of-class activities can be assigned independently or as threaded topics.

Pre-class

ANATOMICAL REVIEW

This module has content that usually appears towards the end of the one semester kinesiology course or serves as basis for an integrated advanced kinesiology course. Students can revisit the previous Chapters to ensure mastery of foundational knowledge about forces, joint movement, and muscle activity. Topics for flipped classroom questions to guide student preparedness include identification of key joint components that provide stability. Assign general or specific landmarks and key features of the major joint regions discussed in the associated Chapters, including:

- The structures contributing to lower extremity stance when viewed in both sagittal and frontal planes:
    - Hip joint
        - Role of the ligaments in providing stability
    - Knee complex
        - Angulations between the femur and the tibia
        - Muscle activity in open and closed chain functional activities
    - Ankle and foot complex
        - Pronation/supination in weight-bearing
        - Relationship between the knee and ankle in closed chain function
    - The carpal tunnel
- The spinal segments
- Shape of the curves
- Movements of upper vs. lower cervical vertebra in three planes

BIOMECHANICS REVIEW

- This lesson will challenge students to apply biomechanical models, including forces as they affect the body during stance and other functional activities. Help refresh students' ability to identify forces and their sources as it applies to the human body. Simple examples include:
    - Gravitational forces
    - Moments and torques
    - Ground reaction forces
- Kinematics: Have students review normative movements in all planes within all spinal and lower extremity joints. Have them identify both open and closed chain movement patterns.

OTHER TOPICS AND ACTIVITIES

- Have students preview the following Video Clips in the video library:

- **Normal Alignment Resting Posture:** This clip guides students to consider the relative relationship of the body's segments for proper alignment and symmetry. This can be assigned as an LMS discussion topic for students to post after performing a simple postural analysis on classmates prior to the class session to ascertain whether or not posture is within normal limits.
- **Normal Gait Cycle (Ankle Focus):** This clip allows students to familiarize themselves with the terminology relating to the normal gait cycle. Coupled with the **Normal Gait Cycle Sagittal View (Full Body)** and **Normal Gait Cycle Frontal Plane Motion** clips, students can preview the observational gait analyses processes and the related terminology. Another discussion thread can be generated as students are asked to complete a gait analysis on a classmate.

- Assign the Labeling Activities. The first three Labeling Activities require students to identify the aspects of posture, identifying anatomical structures (muscles and ligaments) as well as forces and moments. Labeling #4 challenges students to label correctly phases of the gait cycle.
- Assign the Hot Spot Activity, which requires students to identify correctly the curvatures found within the spine.
- Ask the students to complete the Pretest portion of the module before coming to class. Students should come to class with a list of questions they missed for further review.
- Prior to class, review the students' performance on the Pretest.
- Consider posting a discussion board topic that allows students to post questions about the material.

In-class

- Students can be assigned or reassigned the Labeling and Hot Spot Practice Activities during class. You may also provide additional active learning opportunities by using other images for labeling with guidance from the textbook and without immediate computerized feedback.
- Students can also repeat the Pretest to ensure that learning has occurred and to ensure they understand regional concepts before advancing to material that is more complex.
- Have students report on pre-class assessments of classmates' posture and gait, with the instructor summarizing the discussion board themes.
- Integrate the four preparatory videos to ensure that students obtain the requisite knowledge about what constitutes normal postural alignment and gait: **Normal Alignment Resting Posture, Normal Gait Cycle, Normal Gait Cycle Sagittal View,** and **Normal Gait Cycle: Frontal Plan Motion.**

ACTIVITIES RELATING TO POSTURE

- The Text Generation exercises can be used to introduce abnormal posture respective to the LOG and positioning, students can do two different in-class active learning assignments. (Alternatively, these may be assigned for out-of-class follow-up assignments if multiple sessions are devoted to posture). In Text Generation #1, students are required to make judgments regarding the postural changes of the older individual seen in the image. Similarly, in Text Generation #3, students are queried about the gravitational moments seen as the subject stands with extreme hyperextension of the spine.

- The series of Critical Thinking Exercises provides the instructor and students with information about pathological gait and deviations from normal. In particular, critical thinking #2, **Thoracic Kyphosis: Effects on Cervical Spine** (also in the video library and may be assigned without the critical thinking questions); this comprehensive video helps students to relate the interrelationship of spinal segments assessed through static and dynamic postural assessments. The initial part of the video will guide the students' learning about standing posture and body alignment using a plumb line. The therapist explains proper head positioning and demonstrates a forward head posture on a subject in standing. The first question challenges students to consider the LOG relative to the spinal segments. As the video continues, the therapist details how changes in posture effect movements in other areas. The video shows limitations in cervical spine rotation as well as impairment to temporomandibular joint function. The two additional questions presented to the students tests their ability to identify specific anatomic changes as a result of the abnormal posture. Have students replicate this activity by asking students to adopt standing postures with and without thoracic spinal deviations. This exercise can be expanded to include changes at the lumbar spine/pelvis or in the frontal plane, as with scoliosis.

ACTIVITIES RELATING TO GAIT

- Prior to advancing to more detailed gait analyses, assign Text Generation #2 to ascertain whether students can correctly identify the phase of gait for the individual featured and answer two more questions about gait speed and double support time. You can expand on the exercise by asking your own follow-up questions about the gait cycle and other parameters routinely measured.
- After students can appreciate full body gait, incorporate the following four Video Clips from the video library that illustrate closely the movements at the ankle, knee, hip, and trunk/upper body.
    - Normal Gait Cycle (Ankle Focus)
    - Normal Gait Cycle (Knee Focus)
    - Normal Gait Cycle (Hip Focus)
    - Normal Gait Cycle (Trunk and Upper Body Focus)
- As an advanced component of the lesson, introduce the effects of interventions on gait. Text Generation #4 provides guided questions for the students to recognize the effects of lower limb bracing on gait patterns. Students consider how the brace enhances knee and ankle function. One question also helps students to think about the abnormal gait pattern if the brace was not present.
- The series of Critical Thinking Exercises address pathological gait and deviations from normal.
    - Critical thinking #1 **The Y Ligament** (also in the video library and may be assigned without the Critical Thinking Questions) helps students to relate the static stability afforded by the Y ligament when standing. The initial part of the video guides the students' learning about standing posture and body alignment. The subject in the video is an individual who sustained a mid-thoracic spinal cord injury and who requires bracing Knee-Ankle-Foot Orthosis (KAFO) to maintain an erect posture in the parallel bars using upper extremity support. The first question challenges students to consider the LOG relative to the hip joint. As the video continues, the physical therapist provides a narrative of the importance of a weight shift to place the LOG posterior to the hip in

order to “hang on the Y ligament.” The next portion shows the subject’s ability to remove his arms and find his balance point. The overlay of information is helpful for students to apply concepts to this clinical activity. The video also includes the individual “jack-knifing” as a result of him moving his hips forward to the LOG. The two additional questions presented to the students elicit higher level thinking about the subject’s positioning and his muscle activation patterns needed to perform the standing activity. The instructor can ask students to replicate this activity and perform the weight shifting in lab.

- Critical Thinking #3 **Gait Assessment: Ascending Stairs** (also in the video library and may be assigned without the critical thinking questions) is a comprehensive video that can help students apply concepts to functional gait assessment and clinical practice. The first portion of the video demonstrates weight acceptance as a subject attempts to step up onto a 2-inch step and a 6-inch step. An excellent review of the necessary ranges needed to accomplish this task is provided for each of the lower extremity joints. Consider stopping the video here and having students perform these two step-ups, comparing the osteokinematic differences between the two tasks. Students are then prompted within the activity to answer a question suggesting that the subject does not have the ability to ascend the 6-inch step. After answering the question, continue the video, which suggests that the subject lacks the adequate knee range of motion and uses a goniometer to illustrate an assessment. You can pause to add another active learning task here by having students perform the 6-inch step-up task with and without the requisite knee range of motion. Resuming the video, the therapist addresses the loss of motion by attempting to restore normal kinematics to the knee through stretching of structures to facilitate additional knee flexion. You can facilitate students’ integration by asking the class to describe the stretching viewed in the video and identify the tissues that are being stressed. This discussion will link with the additional two critical thinking questions, which concern the muscles believed to be critical to the task and the phases involved in the stair cycle.
- Critical Thinking #4: **Ankle Locked at Neutral** Plantarflexion/Dorsiflexion **()and the Impact on Initial Contact Through Foot Flat** (also in the video library and may be assigned without the critical thinking questions) is part of a comprehensive set of videos that incorporate bracing for control of ankle motion and its effects through the stance phases of the gait cycle. The series provides students with images of how an AFO designed to limit range of motion at the ankle requires compensation up the chain in order for the subject to ambulate. Students have the opportunity to view normal gait of the subject without the AFO as well as with the AFO. In this clip, the therapist introduces technology that captures footfall information as the subject walks across a computerized gait mat. Ask the students to qualitatively describe the walking pattern and review the computer output screen from the gait mat. Consider freezing the video when the output from the gait mat appears. Doing so will foster the students’ appreciation for temporal and spatial gait values consistent with a normal or impaired gait. Upon resuming the video, the therapist indicates the need to apply an AFO to control foot drop during gait. The narrative provides students with information on details to key into and to consider how the gait pattern has changed. Students are then

prompted with a question about the biomechanical changes as the subject heel strikes while wearing the AFO. After answering the question, continue the video to help students visualize the AFO's impact at other joints during the initial phase of the gait cycle. Consider pausing here for a discussion about the differences or continue with the video where a split screen appears comparing the subject's gait patterns with and without the AFO. [You may also want to add an active learning task here by having students attempt to walk with an AFO or other mechanism that limits ankle ROM. The final two questions of this activity require the students to consider orthotic application and gait.

  - Critical Thinking #5 **Ankle Locked at Neutral PF/DF and the Impact on Mid-Stance to Late-Stance** provides another opportunity to view the subject's normal and abnormal gait patterns and use the data from the gait mat to quantify gait changes. Questions posed as part of this assignment focus student learning on the expected biomechanical changes that occur during this phase and the potential impact these have on the swing phase.
  - Critical Thinking #6 **Ankle Locked at Neutral PF/DF and the Impact on Push-off** focuses on the push-off phase of gait with an orthotic as a means to clear the toes during swing. You can use this clip to highlight the purpose of the AFO and the compensations needed from other segments within the body. The first question posed helps the student to consider potential issues with the swing phase. Upon resuming the video, the therapist discusses how hip musculature can compensate for the limited ankle motion. As an active learning activity, ask students to perform the latter phase of stance leading to push-off with and without an orthotic. Have them consider how hip flexor muscle activation powers the limbs up. The final two critical thinking questions test the students' understanding of the role of the hip flexors during push-off phase of gait when using the AFO.
  - Critical Thinking #7 **Ankle AFO allowing DF but Preventing PF and the Impact on Gait** (also in the video library and may be assigned without the critical thinking questions)also highlights the role of dorsiflexion range in gait. The questions associated with critical thinking support students' ability to differentiate between gait patterns when dorsiflexion is available when wearing a hinged AFO vs. a solid AFO. The video demonstrates the biomechanical advantages of a hinged AFO and how dorsiflexion contributes to smoother transitions through the stance phase while the restricted plantar flexion reduces issues of foot drop during swing. If available, a student can don both AFO types with classmates actively assessing gait differences. The questions associated with this activity provide students with an opportunity to consider normal gait patterns and the variations when different AFOs are considered.

- For additional active learning, students in small groups can be assigned completion of the Posttest for further exploration of content. In addition, each group must be able to explain/defend why their answers are correct. This critical reasoning is important for reinforcement of learning about normal knee mechanics and altered movement in the presence of injury. As an alternative, the Posttest can be an assignment outside of class, with student groups submitting their respective answers.

Out-of-class

- Incorporate other video library clips into patient cases that can be assigned out of class, with responses either posted to a discussion board, submitted as a graded homework assignment, or used as a part of the subsequent class discussion.
- Assign the two additional videos on crutch walking (**Gait Using One Crutch** and **Gait Using Two Crutches.** Furthering the concepts introduced in the Critical Thinking Videos that incorporate an AFO as an intervention, these two videos assist student learning by presenting a patient diagnosed with multiple sclerosis who requires crutches and an AFO for walking.
- Assign the video **Musculoskeletal Impairment Gait,** which illustrates a woman's gait changes following her recent ACL surgery. The video provides students with the opportunity to perform observational gait analysis and identify the main issue of inadequate knee range of motion. The instructor can create a series of questions for students to discuss the biomechanical changes in the knee joint as a result of the surgery as well as the compensations adopted during the surgical recovery stages.

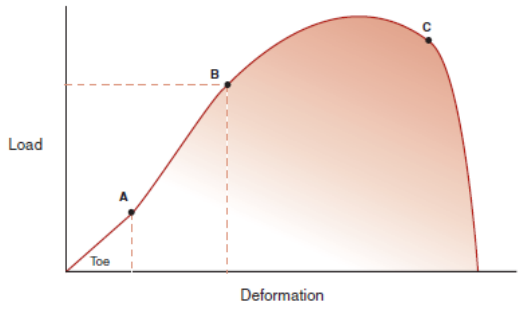
Appendix A

Recommended Answers to Generation Exercises

Use these answers as a guide for grading your students' responses to the generation exercises.

Lesson 1: Foundational Concepts of Kinesiology

Exercise #1



What is the region between point A and point B called? What happens when you remove the load while you are in this region? *Elastic. The tissue returns to its original length.*

What is the region between points B and C called? What happens when you remove the load while you are in this region? *Plastic. There is a permanent change in the tissue's structure, and it will not return to its previous length.*

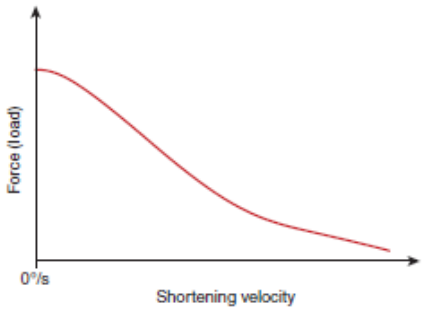
What happens at point C? *The connective tissue has reached its ultimate failure point.*

Exercise #2

Identify whether the movements listed below are classified as roll, spin, or slide.

- Glenohumeral flexion in the scapular plane: *Spin*
- Hip abduction: *Slide*
- Initial phase of knee flexion in standing: *Roll*
- Metacarpophalangeal flexion: *Slide*
- Initial temporomandibular depression: *Roll*
- Radiohumeral supination: *Spin*

Exercise #3



What type of contraction is occurring at the maximum point of force production? *Isometric*

What type of contraction is occurring to the right of the y-axis? *Concentric*

Why does the amount of force produced decrease as the shortening velocity increases? *As the speed of shortening increases, less actin and myosin linkages are made, resulting in decreased force production.*

If the graph included data points to the left of the y-axis (lengthening velocity), would the line incline or decline as it moved further to the left? *It would incline, because eccentric force production increases with increased speed.*

Lesson 2: Axial Skeleton

Exercise #1

Identify whether FLEXION or EXTENSION is occurring in the following situations:

- Intervertebral foramen gets smaller: *Extension*
- Anterior annulus bulges slightly: *Flexion*
- Inferior articular process (superior portion of motion segment) glides superiorly: *Flexion*
- Spinous processes approximate: *Extension*
- Nucleus pulposus migrates posteriorly: *Flexion*
- Posterior annulus becomes taut: *Flexion*
- Superior vertebral body translates anteriorly: *Flexion*
- Ligamentum flavum bulges into spinal canal: *Extension*

Exercise #2

What is the gravitational moment on the thoracic spine? *Extension*

In what direction is the pelvis rotated? *Anteriorly. Note the contour of the lower lumbar spine and lower abdomen.*

Lifting the right arm off the ground while keeping the trunk in the same position would require significant increase in which abdominal muscles? *The left external oblique and right internal oblique as well as the transversus abdominus*

What is the gravitational moment on the cervical spine? *Flexion*

Exercise #3

During flexion, which muscle is active first? *Erector spinae*

Is this concentric or eccentric activity? *Eccentric*

During the return to upright, which muscle is active first? *Biceps femoris*

Is this concentric or eccentric activity? *Concentric*

Describe the sequence of lumbar and hip motion you would expect to see from this individual during forward bending and return to upright. *Forward bend: lumbar flexion then hip flexion. Return to upright: Hip extension then lumbar extension.*

Lesson 3: Chest Wall and Temporomandibular Joint

Exercise #1

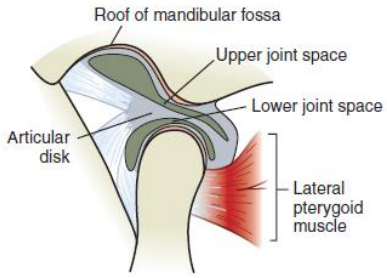
Name the primary muscles of respiration and describe their actions.

Diaphragm. *Attachments along the entire lower border of the rib cage form a dome, separating the abdominal contents from the thoracic cavity. Contraction flattens the dome, causing a negative pressure in the lung that results in inspiration.*

Internal intercostal muscles. *The parasternal portion of these muscles is located anteriorly, starting at the costosternal junction and continuing posteriorly to the angles of the ribs. Deep to the external intercostals, the fibers run posteriorly and caudally from superior rib to inferior rib. Contraction aids in quiet respiration.*

Scalenes. *The anterior, middle, and posterior scalenes attach to the upper two ribs. Contraction from superior attachments on the cervical transverse processes of C3 to C7 elevates the two ribs, causing the manubrium to elevate. This is known as the pump handle motion.*

Exercise #2



In the image shown, is the mandible elevated or depressed? How do you know? *Depressed. The mandibular condyle has glided anteriorly to the mandibular fossa.*

What tissue is stretched in this position? *Superior lamina (retrodiscal tissue).*

If you are looking at the right side and the left side appears to be in a position where the mandibular condyle is in the mandibular fossa, what is the position of the mandible? *Deviated to the left.*

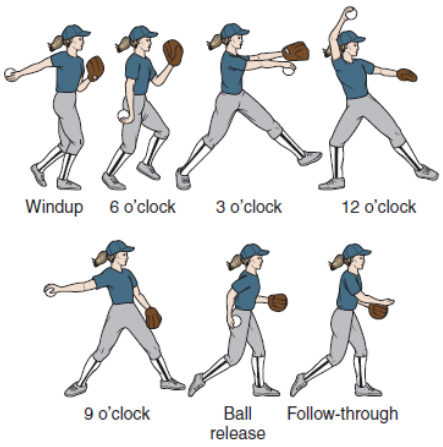
Exercise #3

Name the mandibular motion resulting from the following combinations of muscle contractions:

- B Masseter, B Temporalis, B Medial Pterygoid: *Elevation*
- L Lateral Pterygoid, R Masseter: *R lateral deviation*
- B Lateral Pterygoid, B Medial Pterygoid: *Protrusion*
- B Lateral Pterygoid, B Digastric: *Depression*

Lesson 4: The Shoulder Complex

Exercise #1



Given the windmill softball pitching motion identified in the image shown, list the activity level (peak, high, moderate, minimal, or none) of the supraspinatus muscle at each phase (windup, 6 o'clock, 3 o'clock, 12 o'clock, 9 o'clock, ball release, and follow-through). *Answers should reflect the information in the table shown.*

	Wind-up	**6:00-3:00**	**3:00-12:00**	**12:00-9:00**
Peak				
High		X		
Moderate	X		X	
Minimal				X
None				

Exercise #2

Identify two muscles that are failing to appropriately stabilize the scapula in this patient. Identify an exercise for each of those muscles. *1.) Rhomboids—scapular adduction via rowing; 2.) Serratus anterior —scapular retraction.*

Lesson 5: The Elbow Complex

Exercise #1

Identify the attachments of the triceps muscle. *Proximal attachments = long head—infraglenoid tubercle of the scapula, lateral head—posterior surface of proximal humerus, medial head—posterior surface of distal half humerus; distal attachments = olecranon process of the ulna.*

Identify the three motions of the triceps muscle. *1.) Extension of the shoulder; 2.) Extension of the elbow; 3.) The long head also adducts the shoulder.*

What is the position of maximal force generating capacity? Why? *Neutral shoulder with mid-range elbow flexion; this is the optimal length-tension relationship for maximal triceps force production.*

What is the position of active insufficiency? *Position in which the triceps is maximally shortened = full shoulder and elbow extension.*

What is the position of passive insufficiency? *Position in which the triceps is maximal lengthened = full shoulder and elbow flexion.*

Exercise #2

Identify the surfaces of the elbow articulations. *Capitulum and trochlea are convex, and the olecranon fossa is concave.*

Why is the carrying angle of the elbow a valgus position? *The medial epicondyle (trochlea) extends further distally than the lateral epicondyle (capitulum).*

When moving into flexion in open chain, what are the directions of the elbow arthrokinematics? *Concave ulna rolls and glides anteriorly on the convex humerus.*

Does this change with closed chain motions? If so, how? If not why? *Yes. In closed chain, the proximal segment (humerus) moves on the distal segment (ulna), which means that the convex surface of the humerus rolls anteriorly and glides posteriorly on the ulna.*

Lesson 6: The Wrist and Hand Complex

Exercise #1

Using a blood pressure cuff rolled up and inflated to 30 mm Hg, explore the strength of gripping with the wrist in varying degrees of flexion and extension. In what wrist position is the grip the greatest? Why? *Grip is greatest with wrist extension with ulnar deviation because of the length-tension relationship of the multi-articulate muscles of the wrist and hand. Wrist extension helps to take up the slack of the finger flexors to prevent active insufficiency.*

Exercise #2

If an individual is lacking wrist extension after a radial fracture, which direction should a clinician glide the proximal carpals on the distal radius to enhance motion? Why? *Glide anteriorly because convex proximal carpals will glide posteriorly and roll anteriorly on a concave distal radius.*

Lesson 7: The Hip Complex

Exercise #1

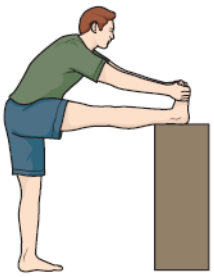
When lowering a box to the floor, what type of muscle action is being performed at the hips? *Eccentric hip extension*

What muscles are responsible for this motion? *Gluteus maximus, biceps femoris, semitendinosus, and semimembranosus*

Genu valgus is an undesirable component of a squat. What muscles of the hip are important to prevent genu valgus? *Hip external rotation (ER) is an effective way to control genu valgus. The muscles responsible for hip ER are the gluteus maximus, superior fibers of the piriformis, obturator internus and externus, gemellus superior and inferior, and posterior fibers of gluteus medius.*

When performing a squat, how can you prevent excessive stress on the knees with increasing knee flexion? *Keep the knees behind the toes; if you are more concerned about reducing stress on the hip, allowing the knees to pass anterior to the toes is acceptable.*

Exercise #2

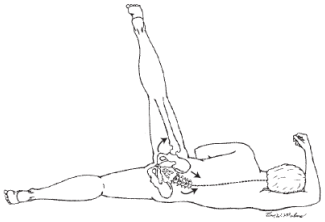


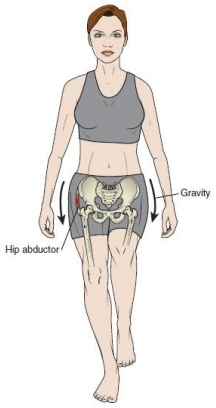
What muscle is passively insufficient during the motion shown? *Hamstrings*

Why is this muscle passively insufficient? *It is elongated over both the hip and knee joints.*

If this individual is limited in hip flexion due to posterior muscle tension, what could be done to increase hip flexion? *Flex the knee.*

Exercise #3





Discuss the coupled motions of the pelvis and lumbar spine. When the hip is abducted in closed kinetic chain motion, what is the associated lumbar motion? *Hip abduction is associated with hip hiking and lumbar lateral flexion.*

What class lever is open kinetic chain hip abduction? *First class*

Exercise #4

Describe the surfaces of the hip joint. Based on relationship of these surfaces, what are the arthrokinematics of the hip joint when the osteokinematic motion is open-chain hip flexion? *With hip flexion, the convex femoral head rolls anteriorly and glides posteriorly in the acetabulum.*

What are the muscles performing this motion? *Iliacus, psoas major, tensor fasciae latae, sartorius, rectus femoris*

Lesson 8: The Knee

Exercise #1

An athlete had an ACL reconstruction. The athlete has decreased knee flexion. Given the structure of the joint surfaces, in what direction should you glide the tibia to facilitate knee flexion? *In open kinetic chain, the concave tibia will roll and glide posteriorly on the femur for knee flexion. Gliding the tibia posteriorly will enhance knee flexion.*

Does this change if the femur is mobilized on the tibia? *Yes. If the femur is moved on the tibia, the arthrokinematics are now convex on concave. That means the femur will roll posteriorly and glide anteriorly during closed kinetic chain knee flexion.*

Lesson 9: The Ankle and Foot Complex

Exercise #1

An individual experienced an Achilles tendon injury and now presents with limited ankle dorsiflexion. What are the arthrokinematics that would be helpful to restore this motion? *The convex talus roll anteriorly and slide posteriorly on the concave tibial mortise.*

Exercise #2

Given the common nature of lateral ankle sprains:

What is the common motion that would stress the lateral ligaments? *Talocrural inversion*

What additional motions would isolate the following ligaments?

- Anterior talofibular: *Is most often injured with inversion and plantarflexion (e.g., stepping in a hole or on someone's foot)*
- Calcaneofibular: *Stabilizes the talus in the mortise; prevents inversion and dorsiflexion*
- Posterior talofibular: *Prevents inversion and dorsiflexion*

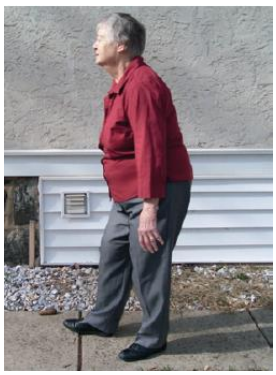
Palpate each of these ligaments and perform the appropriate motions to stress each ligament.

Lesson 10: Integrated Function: Posture and Walking

Exercise #1

Given the line of gravity in the figure above, give the gravitational moment at the ankle, knee, hip, lumbar spine, and cervical spine. *Ankle = dorsiflexion, knee = flexion, hip = extension, lumbar spine = extension, and cervical spine = extension*

Exercise #2



Describe some of the changes in posture you see in the figure shown. What are these changes often characteristic of? *Knees and hips are flexed. The trunk leans forward. Increased kyphosis and forward head position.*

Is the cervical lordosis increased or decreased? *Aging*

Where is the line of gravity relative to a more normal posture? *Anterior to the normal line of gravity*

Exercise #3

Name the phase of gait for the left lower extremity in the figure shown. *Heel strike, or initial contact*

Do you think the person above is walking quickly, slowly, or at a normal speed? Why? *Slowly. The right heel is still on the ground as the opposite leg makes its initial contact.*

Is her time in double support increased or decreased compared to normal? *Increased. Time of double support decreases as speed increases. Running begins at the time there is no longer any double support.*

Exercise #4

Notice the brace on the person in the illustration shown. How might the brace help with gait at the ankle? *It can prevent plantarflexion of the ankle during swing phase, stopping the foot from dragging.*

How might the brace help with gait at the knee? *It can prevent the knee from snapping into hyperextension during stance phase.*

What kind of gait might this person demonstrate if he was not wearing the brace? *Steppage gait. Circumduction may also occur.*

Appendix B

Palpation Practice Activities

Use these practice activities for selected lessons in class, as a discussion board topic, or as a group activity. Consider having students view the palpation tutorial videos in the video library before practicing.

Lesson 3: Chest Wall and Temporomandibular Joint

ACTIVITY #1

- Palpate the structure just anterior to the external auditory meatus—the tragus.
- Now move just anterior to the tragus to palpate the mandibular condyle.
- Open and close your mouth to feel this structure move.
- See whether you can feel the difference between rolling and gliding.
    - Open slightly with your tongue on the roof of your mouth to feel rolling.
    - Protract or laterally deviate your mandible to feel gliding.
- From the condyle move inferiorly along the mandibular ramus until it changes direction at the angle of the mandible.
- While palpating the angle of the mandible, clench your teeth together.
    - Do you feel a muscle contract?
    - What muscle is it?

ACTIVITY #2

- Palpate the angled inferior border of your right and left rib cage. Move superiorly along the inferior border until they meet in the mid line. Here you will find the xiphoid process.
- Move superiorly to palpate the body of the sternum.
- Continue palpating superiorly along the sternum until you feel a horizontal line—the manubriosternal joint at the level of the second rib and then the manubrium above this joint.
- Put your hands on your upper chest above the nipple level. Take a deep breath to feel the rib's pump handle motion, which will feel like the ribs are elevating and moving anteriorly.
- Place your hands on your lateral rib cage near the lower half of your rib cage. Take a deep breath and notice the bucket handle motion of the ribs, which will feel like the ribs are elevating and moving laterally.

Lesson 4: The Shoulder Complex

Palpate each one of the rotator cuff muscles on a colleague.

Supraspinatus

- In prone, find the spine of the scapula.
- Roll superior into the supraspinatus fossa.
- Follow the supraspinatus under the acromion to the distal attachment at the greater tubercle of the humerus.
- Resist shoulder abduction to confirm.

Infraspinatus

- In prone, find the spine of the scapula.
- Roll inferior into the infraspinatus fossa.
- Follow the infraspinatus laterally to the greater tubercle of the humerus.
- Resist shoulder external rotation to confirm.

Teres minor

- In prone, with the arm over the side of the table, identify the inferior angle of the scapula and follow the lateral border superior toward the axilla.
- When at the superior portion of the lateral border of the scapula, slide lateral onto the infraspinatus.
- Resist shoulder external rotation to confirm.

Subscapularis

- In side-lying, flex the shoulder to 90 degrees.
- Slide your thumb into the axilla between the ribs and the scapula.
- Flex your thumb to ease into the subscapular fossa and palpate the subscapularis.
- Resist shoulder internal rotation to confirm.

Lesson 5: The Elbow Complex

- With your elbow in extension, identify the epicondyles of the humerus and the olecranon of the ulna. Note how the three structures are in a straight line.
- What happens to this alignment with elbow flexion? Why does this happen?
- Does the alignment of these structures change with pronation or supination? Why or why not?

Lesson 6: The Wrist and Hand Complex

ACTIVITY #1

Practice this sequence to palpate the carpal bones.

Proximal row—scaphoid, lunate, triquetrum, pisiform

- **Scaphoid:** Begin at the radial styloid and slide your finger distally and slightly posterior, reaching the hollow space between the extensor pollicis longus and brevis.
- **Lunate:** Slide laterally from the scaphoid onto the lunate; you will know you are on the lunate if you feel the bone move anteriorly with wrist extension.
- **Triquetrum:** Slide laterally again onto the triquetrum. You will know you are on the triquetrum if you are immediately distal to the ulnar styloid. If you abduct the wrist, the triquetrum protrudes, and when you adduct, the wrist it will disappear.
- **Pisiform:** Find the distal, medial joint line of the wrist and move slightly distal and onto the pea-shaped projection.

Distal row—trapezium, trapezoid, capitate, hamate

- **Trapezium:** Option 1: Locate the scaphoid and move distally along the first ray. Option 2: Identify the first metacarpal and move proximally onto the trapezium.
- **Trapezoid:** Option 1: Locate the scaphoid and move distally along the second ray. Option 2: Identify the second metacarpal and move proximal to the trapezoid.

- **Capitate:** Option 1: Locate the lunate and move distally along the third ray. Option 2: Identify the third metacarpal and move proximal to the capitate.
- **Hamate:** Option 1: Locate the triquetrum and move distally along the fourth and fifth rays. Option 2: Identify the space between the fourth and fifth metacarpals and move proximally onto the hamate. On the anterior surface, if you locate the pisiform, move slightly distal on an angle toward the index finger and onto the hook of the hamate.

ACTIVITY #2

Identify the medical epicondyle of the elbow. Now trace the path of each of the wrist flexor muscles.

Flexor carpi radialis

- With the forearm in supination, resist wrist flexion.
- Identify the most lateral tendon at the wrist; this is the flexor carpi radialis (FCR).
- Confirm that you are on the FCR by recruiting it to abduct the wrist.
- Now trace this tendon back to the medial epicondyle.

Palmaris longus

- With the forearm in supination, resist wrist flexion.
- Identify the second tendon from the lateral side of the wrist; this is the palmaris longus. (Take note that some people do not have a palmaris longus.)
- Trace this tendon back to the medial epicondyle.

Flexor digitorum

- With the forearm in supination, place your fingers in the middle of the wrist, just proximal to the joint line.
- Wiggle the fingers like you are playing the piano; the tendon that is moving is the flexor digitorum.
- Trace this tendon back to the medial epicondyle.

Flexor carpi ulnaris

- With the forearm in supination, resist wrist flexion.
- Identify the most medial tendon at the wrist; this is the flexor carpi ulnaris (FCU).
- Confirm that you are on the FCU by recruiting it to adduct the wrist.
- Trace this tendon back to the medial epicondyle.

Lesson 8: The Knee

Follow the path of each of the muscles.

Biceps femoris

- In prone, locate the ischial tuberosity and move distally. This is the common tendon of the hamstrings.
- On the lateral aspect of the posterior femur is the biceps femoris.
- Resist knee flexion while palpating laterally to confirm proper identification.

Semitendinosus

- In prone, locate the ischial tuberosity and move distally. This is the common tendon of the hamstrings.

- On the medial aspect of the posterior femur is the semitendinosus and semimembranosus. The semitendinosus is the more superficial of the two muscles and has a very long tendon.

Gracilis

- The gracilis is medial to the semitendinosus.
- The proximal attachment of the gracilis is the pubic tubercle; it blends in with the semitendinosus and sartorius to attach to the proximal, medial shaft of the tibia as a common tendon—the pes anserinus tendon.

Sartorius

- The sartorius is medial to the gracilis and wraps around from the anterior surface of the femur.
- It begins at the anterior superior iliac spine and blends with the semitendinosus and gracilis to attach to the proximal, medial shaft of the tibia as a common tendon—the pes anserinus tendon.

Semimembranosus

- In prone, locate the ischial tuberosity and move distally. This is the common tendon of the hamstrings.
- On the medial aspect of the posterior femur is the semitendinosus and semimembranosus. The semimembranosus is deep to the semitendinosus.

Lesson 9: The Ankle and Foot Complex

Practice palpating the five tarsals.

Navicular

- Identify the medial and lateral malleoli; the bone between the malleoli is the talus.
- Move medially and distally onto the navicular bone.
- Confirm that you are on the navicular by resisting plantarflexion and inversion.
- The navicular is the attachment of the posterior tibialis.

Cuboid

- The cuboid has six surfaces; it is similar to the hamate of the wrist.
- Identify the styloid process of the fifth metatarsal and follow the lateral border of the foot proximally onto the cuboid bone.

Medial cuneiform

- From the navicular bone, move distally along the medial border of the foot to the medial cuneiform.
- Confirm that you are on the medial cuneiform by continuing distal to the first metatarsal.

Intermediate cuneiform

- From the medial cuneiform, move laterally to the intermediate cuneiform.
- Confirm that you are on the intermediate cuneiform by continuing distal to the second metatarsal.

Lateral cuneiform

- From the intermediate cuneiform, move laterally to the lateral cuneiform.
- Confirm that you are on the lateral cuneiform by continuing distal to the third metatarsal.