Slide 3: The joints of the axial body that will be covered the first part of the PPT are the suture joints and the temporomandibular joints. The general structure of the spine will also be covered in this lesson.

Slide 4: ● All joints between the major bones of the cranium and major bones of the face (other than the TMJ) are suture joints. What are some other joints of the skull that are not suture joints?
The joints of the teeth and the joints between the middle ear ossicles are nonsuture joints of the skull.
- Although suture joints allow little motion, practitioners of craniosacral technique and sacro-occipital technique assert that this motion is very important. When blockage of this motion occurs, these practitioners manipulate the suture joints of the skull.
- Why is movement at these joints important during childbirth?
Movement at the suture joints is important during childbirth because this movement allows the child's head to be compressed as it moves through the birth canal. The uncompressed head is generally too large to make it safely through the birth canal.
- The mobility of the suture joints decreases rapidly as people age, and some of the suture joints eventually ossify and lose all ability to move

Slide 5: The temporomandibular joint (TMJ) is located between the temporal bone and the mandible.
- This joint is of particular importance for bodyworkers and trainers because TMJ dysfunction is fairly common. It is important to be precise when using terminology, so it is inappropriate to simply refer to TMJ dysfunction as "TMJ." TMJ literally means temporomandibular joint.
- Technically, although the TMJ is classified as a uniaxial joint, only the lower joint of the TMJ is actually uniaxial. The upper joint of the TMJ is a gliding nonaxial joint.
- TMJ motion can take place solely at either of these joints, or it can take place as some combination of movements at both of these joints.
- Which of the listed movements are involved in opening the mouth?
Depression and protraction of the mandible at the TMJ are both involved in opening the mouth.
- Which of the listed movements are involved in closing the mouth?
Elevation and retraction of the mandible at the TMJ are both involved in closing the mouth.

Slide 6: ● A and B 1: Elevation and depression are axial movements. Within which plane and about which axis does the TMJ allow elevation and depression?
The TMJ allows elevation and depression within the sagittal plane about a mediolateral axis.
● A and B 2: Protraction and retraction are nonaxial anterior and posterior glide movements.
A and B 3: ● Left lateral deviation and right lateral deviation are nonaxial lateral glide movements.

- Lateral deviation of the TMJ is actually a combination of spinning and gliding. The condyle on the side toward which the deviation occurs spins, and the other condyle glides.

Slide 7: ● The fibrous joint capsule thickens medially and laterally, providing stability to the joint there. What are the names of these thickenings?
The thickenings are often referred to as the medial collateral ligament and the lateral collateral ligament of the TMJ. However, the capsule is fairly loose anteriorly and posteriorly.
- Where are the other three ligaments located?
The temporomandibular ligament is located laterally, and the stylomandibular ligament and the sphenomandibular ligament are located medially.
- The temporomandibular ligament is located on and stabilizes the lateral side of the TMJ. What other functions does the temporomandibular ligament perform?
The temporomandibular ligament also limits depression of the mandible and stabilizes the intra-articular disc.
- What functions do the stylomandibular and sphenomandibular ligaments perform?

The TMJ has an intra-articular disc that divides the joint cavity into two separate joint cavities, an upper cavity and a lower cavity. The TMJ's intra-articular disc can move anteriorly along with the condyle of the mandible. This disc can be seen in Figure 7-6c and Figure 7-6d.

Slide 8: ● The major muscles of the TMJ are the major muscles of mastication. This is true because mastication, which is also known as chewing, involves moving the mandible at the TMJ.
- The temporalis and masseter are located superficially and can be easily accessed when palpating and doing bodywork. The lateral and medial pterygoids are located deeper, and addressing these muscles with bodywork is best done from inside the mouth.
- Another group of muscles that is involved with mastication is the hyoid group. When the suprahyoids contract, if the hyoid bone is fixed, they move the mandible, assisting in mastication. The infrahyoids simultaneously contract isometrically to stabilize the hyoid bone.
- In addition to mandibular movement at the TMJs, mastication also involves muscular action by the tongue to move food within the mouth to facilitate chewing.

Temporomandibular Joint Dysfunction:
- TMJ dysfunction has many possible causes, but the two that are generally of most interest to massage therapists and bodyworkers are listed here.
- What is forward-head posture?
Forward-head posture is a common postural deviation in which the head and often the upper cervical vertebrae are translated anteriorly (forward). This posture is believed to create tension on the TMJs because the hyoid muscles are being pulled taut.

Slide 9: ● The spine is literally a column of vertebrae that are stacked on top of each other. It has **four major regions**, which are listed on the slide. The four regions contain a total of **26 movable elements**.

- **Since the spine must balance the conflicting needs to provide stability and to provide mobility, back and neck problems occur frequently.**
- The cervical spine is located in the neck region, the thoracic spine is located in the thoracic region, the lumbar spine is located in the abdominal/low back region, and the sacrococcygeal spine is located within the pelvis.
- Ideally, the adult spine should be straight when it is viewed posteriorly. Any deviation observed from this view is known as a scoliosis. How is a scoliosis named?
  A scoliosis is named "left" or "right" based on the side of the curve that is convex. A scoliosis can have more than one curve, though; this is known as an S or double-S scoliosis.

- The adult spine, when viewed laterally, should have four curves in the sagittal plane. When are the two primary curves formed?
  The two primary curves are formed first (before birth). These curves are known as kyphotic, which means concave anteriorly and convex posteriorly. A kyphotic curve is a kyphosis.
- When are the two secondary curves formed?
  The two secondary curves are formed second (after birth). These curves are lordotic, which means concave posteriorly and convex anteriorly. A lordotic curve is a lordosis.

Slide 10: ● The adult spine, when viewed laterally, should have four curves in the sagittal plane. When are the two primary curves formed?
The two primary curves are formed first (before birth). These curves are known as kyphotic, which means concave anteriorly and convex posteriorly. A kyphotic curve is a kyphosis.

- When are the two secondary curves formed?
  The two secondary curves are formed second (after birth). These curves are lordotic, which means concave posteriorly and convex anteriorly. A lordotic curve is a lordosis.
- When a baby is born, the spine only has one curve, a kyphotic one. Which two childhood activities cause the creation of the cervical and lumbar lordoses?
  1) Lifting the head requires the spinal joints of the neck to extend, creating the cervical lordosis. The cervical lordosis is required to move the position of the head posteriorly so that its weight is balanced over the trunk.
  2) Sitting up requires the spinal joints of the low back to extend, creating the lumbar lordosis. The lumbar lordosis is required to move the position of the trunk posteriorly so that its weight is balanced over the pelvis.
- A kyphotic curve is a kyphosis; a lordotic curve is a lordosis. These terms are often misused in that they are used to describe an individual who has an excessive kyphotic or lordotic curve. An excessive kyphosis should correctly be termed a hyperkyphosis or a hyperkyphotic curve. An excessive lordosis should correctly be termed a hyperlordosis or a hyperlordotic curve.

Slide 11: ● The spine has four major functions, listed here. The spine provides a base of support for the head and transmits the entire weight of the upper body (including the arms) to the pelvis.
- The spine protects the highly sensitive neural tissue of the spinal cord, which is hidden within the spinal canal formed by the spinal vertebrae.
- The spine must balance structural stability with mobility. Generally, the more stable a joint is, the less it moves. Although each spinal joint usually only allows a small amount of movement, when the movements of all 25 spinal segmental levels are added up, the spine allows a great deal of movement in all three planes.

Slide 12: ● The joints of the axial body that will be covered are the atlanto-occipital joint (AOJ), the atlantoaxial joint (AAJ), and cervical spinal joints. The general structure and functions of the spinal joints will also be covered in this lesson.
- It is interesting to note that a person's height can change by as much as an inch from the time that the person gets up in the morning to the time that the person goes to sleep at night. What can cause this variation?
  This variation can be caused by the compression of the vertebral discs during the day, depending on how much weight-bearing compression the joints are under.

Slide 13: ● Spinal joints are joints that involve two adjacent spinal vertebrae. A spinal joint is named by naming the levels of the two vertebrae involved in the joint. For example, the joint between the third and fourth cervical vertebrae (C3 and C4) is called the C3-C4 joint.
- Each spinal joint is one segment of the many spinal joints in the spine. Each individual joint is referred to as a segmental level of the spine.
- At any one typical segmental level of the spine, one median joint and two lateral joints are present, as shown in the diagram. The median joint is located in the middle, and the lateral joints are located on the sides.

Slide 14: ● A disc joint is composed of what three parts?
A disc joint is composed of an outer annulus fibrosus, an inner nucleus pulposus, and two vertebral end plates.
- The outer annulus fibrosus is composed of a tough fibrous ring of fibrocartilaginous material, the inner nucleus pulposus is composed of a pulplike gel material, and the vertical endplates are composed of cartilage. When a disc pathology occurs, which of these parts does it usually involve?
  Disc pathologies usually involve damage to the annulus fibrosus.

- The discs are actually fairly thick, accounting for 25% of the height of the spinal column. Thicker discs are able to absorb more shock and allow more movement. What other function do the discs perform?
  The discs maintain the opening of the intervertebral foramina (through which spinal nerves travel) by creating a spacer between pairs of vertebral bodies.
- What happens if a disc thins excessively?

A pinched nerve may result, which can lead to a referral of pain, numbness, or weakness.

- The two main functions of a disc joint are to bear the weight of the body and to determine the amount of movement of the spine in that area.
- What percentage of the weight of the body is borne by the spinal disc joints?
  The spinal disc joints bear 80% of the weight of the body above them, and the spinal facet joints bear the other 20% of the weight.

Slide 15: ● The word "facet" is rather generic and refers to any smooth, flat (or nearly flat) joint surface. So, the term "facet" can also be used to refer to joints other than vertebral facet joints.

- Why are these joints called facet joints?
  A vertebral facet joint is called a facet joint because the actual articular surfaces of a facet joint are the facets of the articular processes.
- The main purpose of a facet joint is to guide the movement of the spinal joints. Contrast this with the main function of a disc joint, which is to bear the weight of the body and determine the amount of motion that will occur.
- The planes of the facet determine the type of movement that is best allowed at that level of the spine.
- The cervical facets are generally oriented in an oblique plane that is oriented at an angle of approximately 45 degrees between the transverse and frontal planes. This means that these facet joints freely allow motion in the transverse and frontal planes.

Slide 16: ● B - The thoracic facets are generally oriented within the frontal plane. This means that these facet joints freely allow motion in the frontal plane.

- C - The lumbar facets are generally oriented within the sagittal plane. This means that these facet joints freely allow motion in the sagittal plane.

Slide 17: Spinal joints allow flexion and extension within the sagittal plane around a mediolateral axis, as shown in Figure 7-15.

- Spinal joints allow right lateral flexion and left lateral flexion within the frontal plane around an anteroposterior axis, as shown in Figure 7-16.
- Spinal joints allow right rotation and left rotation within the transverse plane around a vertical axis, as shown in Figure 7-17.

Slide 18: ● Spinal joints allow gliding translational movements in three directions. As shown spinal joints allow right-side and left-side translation, anterior and posterior translation, and superior and inferior translation.

Slide 19: ● The major ligaments of the spine are shown here. They provide stability to the spine by limiting excessive spinal motions.

- Note that, in all cases, the ligaments of the spine limit motion that would occur in the direction opposite to the location of the ligament. For example, anterior ligaments limit the posterior motion of vertebral extension.

Slide 20: ● The fibrous joint capsules of the facet joints stabilize the facet joints and limit the extremes of all spinal joint motions except extension and inferior translation.
- The annulus fibrosus of the disc joints stabilizes the disc joints and limits the extremes of all spinal joint motions except inferior translation.
- The anterior longitudinal ligament limits extension of the spinal joints.
- The posterior longitudinal ligament limits flexion of spinal joints.
- Two ligamentum flava limit flexion of the spinal joints.
- The interspinous ligaments are separate short ligaments that limit flexion of the spinal joints.
- The supraspinous ligament limits flexion of the spinal joints.
- The intertransverse ligaments are separate short ligaments that limit contralateral (opposite-sided) lateral flexion of the spinal joints. These ligaments are usually absent in the neck.
- The nuchal ligament runs along and between the spinous processes from C7 to the external occipital protuberance of the skull. This ligament is often described as a combination of the interspinous and supraspinous ligaments of the cervical region. There is some question as to whether tension on the nuchal ligament could create an adverse pull on the dura mater.

Slide 21● Figure 7-20 shows how the major ligaments of the spine limit motion.
- Figure 7-20a shows the anterior longitudinal ligament becoming taut to limit the extension of the superior vertebra.
- Figure 7-20b shows all of the ligaments on the posterior side (the supraspinous, interspinous, ligamentum flavum, and posterior longitudinal ligaments) becoming taut to limit the flexion of the superior vertebra.
- Figure 7-20c shows the intertransverse ligament on the left side becoming taut to limit the right lateral flexion of the superior vertebra.

Slide 22: ● What are some examples of muscles that belong to these groups of muscles?
The erector spinae group, the transversospinalis group, and other muscles of the posterior neck and trunk are examples of spinal extensor muscles.
Muscles of the anterior abdominal wall and muscles in the anterior neck are examples of spinal flexors.
Most flexors and extensors are also lateral flexors. All lateral flexors are ipsilateral lateral flexors.
Prominent rotators of the trunk include the external and internal abdominal obliques and the transversospinalis group muscles.

Slide 23: ● The atlanto-occipital joint (AOJ) is a cervical joint that is located between the atlas (C1) and the occiput. It connects the neck and the head.
- How many facet joints does the AOJ have?
The AOJ is formed by the superior articular facets of the atlas meeting the occipital condyles. Therefore, the AOJ has two lateral joint surfaces (facet joints).

- Because the atlas has no body, it has no intervertebral disc. Therefore, no median disc joint (intervertebral disc joint) exists for the AOJ.

Slide 24: ● Movement of the AOJ allows the cranium to move relative to the atlas.
- Note: The amount of rotation that is possible at the AOJ is considered negligible by many sources, so they classify the AOJ as being biaxial, rather than triaxial.
- Even though the head usually moves with the neck, the head and the neck are separate body parts and can move independently of one another. The AOJ makes this independent motion possible.
- Figure 7-23 shows flexion and extension of the head at the AOJ. In what plane and around what axis do these motions take place?
  Flexion and extension of the head at the AOJ take place in the sagittal plane around a mediolateral axis.
- Flexion and extension of the head at the AOJ are the primary motions of the AOJ.
- The motion of nodding the head is primarily created by flexing and extending the head at the AOJ.
- Figure 7-24 shows right lateral flexion and left lateral flexion of the head at the AOJ. In what plane and around what axis do these motions take place?

Right lateral flexion and left lateral flexion of the head at the AOJ take place in the frontal plane around an anteroposterior axis.
- Figure 7-25 shows right rotation and left rotation of the head at the AOJ. In what plane and around what axis do these motions take place?
  Right rotation and left rotation of the head at the AOJ take place in the transverse plane around a vertical axis.

Slide 25: ● The atlantoaxial joint (AAJ) is a cervical joint that is located between the atlas (C1) and the axis (C2). The AAJ allows the atlas to move on the axis.
- Because the atlas has no body, it has no intervertebral disc.
- The AAJ is composed of one medial joint and two lateral joints. The median joint of the AAJ is the atlanto-odontoid joint.

Slide 26: ● The atlanto-odontoid joint is formed by the anterior arch of the atlas meeting the odontoid process (dens) of the axis. This joint actually has two synovial cavities.
- The two lateral joints of the AAJ are facet joints.
- Although the AAJ is often described as being a uniaxial pivot joint, the AAJ allows motion in two planes around two axes. Therefore, all three AAJs (the median joint and the two lateral joints) are technically biaxial joints.
- Approximately 50% of cervical rotation (indicating "no" to someone) occurs at the AAJ.
- In what plane and around what axis do right rotation and left rotation take place?
  Right rotation and left rotation of the atlas at the AAJ take place in the transverse plane around a vertical axis. These are the primary motions of the AAJ.
- In what plane and around what axis do flexion and extension take place?
  Flexion and extension of the atlas at the AAJ take place in the sagittal plane around a mediolateral axis.

- Right lateral flexion and left lateral flexion at the AAJ are negligible.
- The average ranges of motion of the atlas at the atlantoaxial joint (AAJ) (C1-C2 joint) from anatomic position are listed on the slide.
- As was mentioned earlier, the range of motion of the AAJ for left and right lateral flexion is negligible.
- However, the ranges of motion for right and left rotation are significantly larger for the AAJ than they are for the AOJ.
- Many muscles cross the AOJ and the AAJ, but the muscles listed here should especially be noted.
- What are some members of the suboccipital group?

The rectus capitis posterior major, the rectus capitis posterior minor, the obliquus capitis inferior, and the obliquus capitis superior are all members of the suboccipital group.

Slide 27: ● The cervical spine defines the neck as a body part. The cervical spine is composed of seven vertebrae that are labeled, from superior to inferior, C1 through C7.

- The cervical spine has a lordotic curve.
- The first cervical vertebra (C1) is also known as the atlas because it holds up the head.
- The second cervical vertebra (C2) is also known as the axis because its toothlike dens creates an axis around which the atlas can rotate. Also, it is worth noting that the spinous process of C2 is rather large and can be a valuable landmark for palpation.
- The seventh cervical vertebra (C7) is also known as the vertebral prominens because it is the most prominent cervical vertebra, making it a valuable landmark for palpation.

The cervical spine is the second most frequent source of joint disease and back pain. The first, of course, is the lumbo-sacral spine.

Slide 28: ● Cervical vertebrae have transverse foramina in their transverse processes. The cervical transverse foramina allow two vertebral arteries to pass superiorly to the skull.

- The cervical spine has bifid processes. This means that each cervical spinal vertebra has two points instead of one.
- Most transverse processes of the cervical spine are bifid transverse processes, and the two aspects are known as the anterior and posterior tubercles.
- The cervical spine also has uncinate processes.
- Here, it is possible to see all of the special characteristics of the cervical spine.
- Uncinate processes are the upward curves of the lateral sides of the superior surfaces of the bodies of cervical vertebrae.
- An uncovertebral joint (often known as joints of the Von Luschka) is where the lateral sides of two adjacent cervical vertebrae meet each other. The uncovertebral joints provide additional stability to the cervical spine. Why?
  Because the uncovertebral joints serve to mildly limit frontal and transverse plane motions of the cervical vertebrae.

Slide 29: ● Since only the head is superior to the neck, the cervical spine has less of a weight-bearing function than the thoracic and lumbar regions. This allows the cervical spine to be the most mobile region of the spine.

- What structural features of the cervical spine contribute to the high mobility of this region of the spine?
  The extra thickness of the intervertebral discs in the cervical spine contribute to its high mobility. The orientation of the cervical facet joints account for the impressive ability of the upper neck to rotate in the transverse plane.
- For more information about the gliding translational movements of the cervical spine, see Slide 42.
- Note: Because the facet joints of the cervical spine are oriented between the transverse and frontal planes, when the cervical spine laterally flexes, it ipsilaterally rotates as well.
- It should be noted that the motions depicted on the next two slides (in Figure 7-33) involve the entire craniocervical region.
- Figure a–b shows flexion and extension of the neck and head. In what plane and around what axis do these motions take place?
  Flexion and extension of the neck and head take place in the sagittal plane around a mediolateral axis.
- Figure c–d shows right lateral flexion and left lateral flexion of the neck and head. In what plane and around what axis do these motions take place?
  Right lateral flexion and left lateral flexion of the neck and head take place in the frontal plane around an anteroposterior axis.
- Figure e–f shows right rotation and left rotation of the neck and head. In what plane and around what axis do these motions take place?
  Right rotation and left rotation of the neck and head take place in the transverse plane around a vertical axis.

Slide 30: none

Slide 31:
- The joints of the axial body are the thoracic spinal joints, the rib joints, and the lumbar spinal joints. The general structure and functions of the thoracolumbar spine will also be covered in this lesson.
- Last, but not least, the lesson will cover the structures and functions of the thoracolumbar fascia and the abdominal aponeurosis.

Slide 32:
- The thoracic spine defines the thorax of the body (the upper part of the trunk). The thoracic spine is composed of 12 vertebrae that are labeled, from superior to inferior, T1 through T12. What do the 12 thoracic vertebrae correspond to?
  The 12 thoracic vertebrae correspond to the 12 pairs of ribs that articulate with them.
- The thoracic spine has a kyphotic curve.
- The spinous processes of the thoracic spine are long and oriented inferiorly, so they obstruct and limit the extension of the thoracic spine.
- Generally, each rib has two costospinal articulations with the spine: the costovertebral joint and the costotransverse joint.
- The term "costospinal joints" refers to both costovertebral joints and costotransverse joints. What are costovertebral and costotransverse joints?

A costovertebral joint is one in which the rib meets the bodies/discs of the spine. A costotransverse joint is one in which the rib meets the transverse process of the spine.

- Both costovertebral and costotransverse joints are synovial joints.

Slide 33: ● The costospinal joints are nonaxial and allow gliding. They stabilize the ribs by giving them a posterior attachment to the spine, and they allow the ribs to move relative to the spine.

- The thoracic spine is far less mobile than the cervical and lumbar regions of the spine. Since the thoracic spine is less mobile, it is also more stable, meaning that it gets injured less often than the other regions of the spine. What is the major reason for the lack of mobility of the thoracic spine?

The presence of the ribcage in this region is the primary reason for the lack of mobility of the thoracic spine.

- Flexion and extension of the trunk take place in the sagittal plane around a mediolateral axis.
- Right lateral flexion and left lateral flexion of the trunk take place in the frontal plane around an anteroposterior axis.
- Right rotation and left rotation of the trunk take place in the transverse plane around a vertical axis.
- Gliding translational movements of the trunk take place in all three directions.

Slide 34: ● There are three types of rib joints. The costospinal joints are the joints between the ribs and the spinal column. They have already been touched on, but here they will be covered in more detail. What are the sternocostal and intrasternal joints?

The sternocostal joints are the joints between the ribs and the sternum, and the intrasternal joints are the joints that connect the three parts of the sternum to each other.

Slide 35: Usually, each rib has two articulations with the spine, a costovertebral joint and a costotransverse joint. The costovertebral joint is the joint where the rib meets the vertebral bodies/discs, and the costotransverse joint is where the rib meets the transverse process of the spinal vertebra.

- The typical thoracic vertebral body has two costal hemifacets: one superiorly and one inferiorly. The head of the rib forms a joint with what three surfaces?
  The head of the rib forms a joint with the inferior costal hemifacet of the vertebra above, the superior costal hemifacet of the vertebrae below, and the intervertebral disc that is located between the two vertebral bodies.
- The costovertebral joint is stabilized by two ligamentous structures: its fibrous joint capsule and the radiate ligament.

Slide 36: ● The typical thoracic vertebra has a full costal facet on its transverse processes. The costotransverse joint is where the tubercle of the rib meets the transverse process of the thoracic vertebra.

- The costotransverse joint is stabilized by the four ligamentous structures listed here.

Slide 37: ● Seven pairs of sternocostal joints attach the ribs to the sternum anteriorly. Which ribs belong to each of the three categories listed here?

The first seven pairs of ribs attach directly onto the sternum via their costal cartilages and are known as true ribs. The eighth through tenth pairs of ribs join the costal cartilage of the seventh rib pair (rather than connecting to the sternum directly) and are known as false ribs. The eleventh and twelfth rib pairs do not attach to the sternum at all and are known as floating false ribs.

- The structure and function classifications for the sternocostal joints are listed here.
- Which of the two sternocostal articulations (the costochondral joint and the chondrosternal joint) provides more movement?
  The chondrosternal joint is a gliding synovial joint, so it provides more movement than the costochondral joint, which has no joint capsule or ligaments.
- What are interchondral joints?
  Interchondral joints are joints that are located between adjacent costal cartilages of ribs #5 through #10.
- The ligaments of the sternocostal joints are listed here. Notice that there are no ligaments for the costochondral joints.

Slide 38: Two intrasternal joints are located between the three parts of the sternum. The manubriosternal joint is located between the manubrium and the body of the sternum, and the sternoxiphoid joint is located between the body and the xiphoid process of the sternum.

- The intrasternal joints are stabilized by the ligaments listed here.
- What are the joint classifications of the intrasternal joints?
  Both of the intrasternal joints are fibrocartilaginous amphiarthrotic joints.

Slide 39: ● What is respiration?
Respiration is the process of taking air into and expelling air out of the lungs. Inspiration is the process of drawing air into the lungs, and expiration is the process of expelling air out of the lungs.

- The movement of the rib joints can be compared to the movement of a bucket handle. When a rib lifts during inspiration, its movement is very similar to the elevation of a bucket handle, so it is often described as a "bucket handle movement."
- During the process of inspiration, the volume of the thoracic cavity increases. Muscles that elevate the ribs are generally categorized as muscles of inspiration, because elevating the ribs causes the thoracic cavity to expand outward. The thoracic cavity can also expand downward into the abdominal cavity, so the diaphragm, which drops down against the abdominal cavity is considered a muscle of inspiration.
- During the process of expiration, the volume of the thoracic cavity decreases. Muscles that depress the ribs are generally categorized as muscles of expiration. The volume of the thoracic cavity can also decrease if the contents of the abdominal cavity push upward into the thoracic cavity, so muscles that can accomplish this movement are also considered muscles of expiration.

Slide 40: ● Abdominal breathing occurs when the diaphragm contracts and its dome drops down into the abdominal cavity, thereby increasing the volume of the thoracic cavity.
● Thoracic breathing occurs when the diaphragm contracts further and it pulls peripherally on the ribcage, elevating the lower ribs and causing the anterior ribcage and the sternum to push anteriorly, thereby increasing the volume of the thoracic cavity.
- During the process of inspiration, the volume of the thoracic cavity increases. Muscles that elevate the ribs are generally categorized as muscles of inspiration, because elevating the ribs causes the thoracic cavity to expand outward. The thoracic cavity can also expand downward into the abdominal cavity, so the diaphragm, which drops down against the abdominal cavity is considered a muscle of inspiration.
- During the process of expiration, the volume of the thoracic cavity decreases. Muscles that depress the ribs are generally categorized as muscles of expiration. The volume of the thoracic cavity can also decrease if the contents of the abdominal cavity push upward into the thoracic cavity, so muscles that can accomplish this movement are also considered muscles of expiration.

Slide 41: ● The lumbar spine defines the abdomen of the body (the lower part of the trunk). The lumbar spine is composed of five vertebrae that are labeled, from superior to inferior, L1 through L5.
- What curve does the lumbar spine have?
  The lumbar spine has a lordotic curve.
- What is the term used for a lumbar spine that has a greater than normal lordotic curve?
  The technical term for this condition is "hyperlordosis," but the common lay term is "swayback."
- The lumbar spine needs to be stable because it has to bear more weight than the cervical and thoracic spinal regions. However, the lumbar spine is also very mobile. Because the lumbar spine tries to balance these two antagonistic goals, the lumbar region of the spine is often injured.
- Flexion and extension of the trunk take place in the sagittal plane around a mediolateral axis.
- Right lateral flexion and left lateral flexion of the trunk take place in the frontal plane around an anteroposterior axis. The lumbar spine couples lateral flexion with contralateral rotation.
- Right rotation and left rotation of the trunk take place in the transverse plane around a vertical axis.
- The lumbar spinal joints allow gliding translational movements in all three directions.

Slide 42: ● The lumbosacral joint is the joint that separates the trunk from the pelvis. What two spinal vertebrae combine to form the lumbosacral joint?
The fifth lumbar vertebra and the sacrum combine to form the lumbosacral (L5-S1) joint.
- The sacral base angle determines the base that the spine sits on. The spine sits on the sacral base of the pelvis. If the angle of the sacral base is anything other than ideal, the curve of the lumbar spine must compensate and change to keep the head level.

Therefore, the sacral base angle is an important factor in assessing the posture of the client's spine.

- The average ranges of motion listed here are the average ranges of motion of the lumbar spine from anatomic position. As can be seen, the lumbar spine allows free motion in most directions, but rotation of the lumbar spine is limited.

Slide 43: ● The thoracolumbar spine includes both the thoracic and lumbar regions of the spine, since they are both located in the trunk. Their motions are often coupled together and assessed together.

- The major motions of the thoracolumbar spine are listed here, and the motions are pictured on the following slides.
- Figure a illustrates flexion of the trunk, and Figure b illustrates extension of the trunk at the spinal joints. These motions take place in what plane and around what axis?

They take place in the sagittal plane around a mediolateral axis.

Figure c illustrates right lateral flexion of the trunk, and Figure 7d illustrates left lateral flexion of the trunk at the spinal joints. These motions take place in what plane and around what axis?

They take place in the frontal plane around an anteroposterior axis.

- Figure e illustrates right rotation of the trunk, and Figure f illustrates left rotation of the trunk at the spinal joints. These motions take place in what plane and around what axis?

They take place in the transverse plane around a vertical axis.

Slide 44: ● The thoracolumbar fascia is a layer of fascia located posteriorly in the thoracic and lumbar regions of the trunk. Two sheets of thoracolumbar fascia exist: one on the left side of the body and one on the right side of the body. The thoracolumbar fascia provides attachment sites for muscles and adds stability to the trunk.

- The thoracolumbar fascia is especially well developed in the lumbar region, where it is divided into three layers. What are these layers?

The three layers of the thoracolumbar fascia in the lumbar region are the anterior layer, the middle layer, and the deep layer.

- All three layers of the thoracolumbar fascia meet posterolaterally, where the internal abdominal oblique (IAO) and the transversus abdominis (TA) muscles attach into it.
- How does the thoracolumbar fascia attach to help stabilize the trunk?

The thoracolumbar fascia's attachments onto the sacrum and the ilium help stabilize the lumbar spinal joints and the sacroiliac joint.

Slide 45: ● The abdominal aponeurosis is a large sheet of fibrous connective tissue that is located anteriorly in the abdominal region. Two sheets of abdominal aponeurosis exist: one on the left side of the body and one on the right side of the body.

- For what muscles does the abdominal aponeurosis provide attachment sites?

The abdominal aponeurosis provides attachment sites for the external abdominal oblique, the internal abdominal oblique, and the transversus abdominis muscles.

- The superior aspect of the abdominal aponeurosis has two layers (anterior and posterior) that encase the rectus abdominis. How many layers does the inferior aspect of the abdominal aponeurosis have?
  The inferior abdominal aponeurosis has only one layer, and that layer passes superficially (anteriorly) to the rectus abdominis.
- The left and right abdominal aponeuroses add stability to the trunk by binding the two sides of the anterior abdominal wall together. What is the name of the midline where the left and right abdominal aponeuroses meet?
  It is called the linea alba, which means "white line."

Slide 46: none

Slide 47: none

Slide 48: ● The bony pelvis comprises the sacrum, the coccyx, and two pelvic bones. Why is it considered a transitional body part?
The pelvis is considered a transitional body part because the two pelvic bones belong to the appendicular skeleton, while the sacrum and coccyx belong to the axial skeleton.

- The sacrum and the coccyx comprise vertebrae that never fully formed. These vertebrae fuse in the coccyx later in life. When does the sacrum fuse?
  The unformed vertebrae of the sacrum fuse embryologically, as do the pelvic bone parts.
- Being a separate body part from both the trunk and the thighs, the pelvis moves relative to the trunk at the lumbosacral (L5-S1) joint and relative to both thighs at the hip joints. Given that bones within the pelvis are also separated by joints, motion within the pelvis is also possible. What is such movement called?
  Such movement is called intrapelvic motion.

Slide 49: Intrapelvic motion happens at the symphysis pubis joint (between the two pubic bones) and at the sacroiliac joints (between the sacrum and the iliac portions of the right and left pelvic bones).

What type of motion is possible at the symphysis pubis joint?
Nonaxial gliding is possible at the symphysis pubis joint.

- Muscles of the abdominal wall and medial thigh stabilize the symphysis pubis joint. Name them.

The stabilizing muscles are the rectus abdominis, the external and internal abdominal obliques, the transverses abdominis of the anterior wall, and the adductor longus, gracilis, and adductor brevis of the medial thigh.

- Allopathic and osteopathic/chiropractic schools of thought disagree over the importance of movement at the sacroiliac joints. While allopathic practitioners downplay the importance of SI motion, chiropractors and osteopaths view the SI joint as perhaps the most important joint of the low back. Why is this?
  The SI joint is important to chiropractic and osteopathic practitioners because it allows motion between the right and left sides of the pelvis.
- Much of the low back pain that people experience is actually sacroiliac joint pain.

- What type of motion is possible at the sacroiliac joints?
  The sacroiliac joints allow nonaxial gliding and the axial movements of nutation and counternutation.
- During nutation the superior sacral base drops anteriorly and inferiorly, while the inferior tip of the sacrum moves posteriorly and superiorly, tilting the pelvic bone posteriorly relative to the sacrum. During counternutation this motion is reversed, tilting the pelvic bone anteriorly relative to the sacrum.

Slide 50: ● The sacroiliac joint is unusual in that it begins as a diarthrotic, synovial joint, allowing an appreciable degree of movement. However, as a person ages, the tremendous weight borne by the joint causes fibrous tissue to be deposited into its cavity to help stabilize the joint, converting the SI into a fibrous, amphiarthrotic joint.
- Which ligaments in the SI joint do not attach directly from the sacrum to the ilium?
  The sacrotuberous and sacrospinous ligaments do not attach directly from the sacrum to the ilium. Hence they provide indirect stabilization
- The SI joint is affected by forces from both above and below. Weight-bearing forces push downward from above while forces of impact (walking, running, jumping) travel upward to the joint through the femurs.
- During pregnancy, the ligaments of the SI joints loosen to allow passage of the baby through the birth canal. The looseness tends to remain through the woman's life, decreasing stability and increasing the predisposition to low-back problems and pain.

Slide 51: ● Although the lumbosacral joint allows only limited motion, the pelvis can anteriorly and posteriorly tilt in the sagittal plane around a mediolateral axis. To move beyond the few degrees of motion allowed, the trunk must move in union with the pelvis. What is this motion called?
This coupling of pelvic and trunk movement owing to the limited range of movement in the lumbosacral joint is called lumbopelvic rhythm.
- The pelvis can depress or elevate on one side in the frontal plane around an anteroposterior axis. Elevation of one side of the pelvis at the lumbosacral joint is always accompanied by depression of the other side of the pelvis.
- When no motion occurs at the hip joints, movement of the pelvis at the lumbosacral joint changes the orientation of the lower extremities; when this happens, the thighs are said to "go along for the ride."
- The pelvis can rotate to the right or to the left in the transverse plane around a vertical axis.
- Movement of the pelvis at the lumbosacral joint is an example of what kind of action?
  Movement of the pelvis at the lumbosacral joint is an example of reverse action because people most often think of the trunk moving relative to a fixed pelvis rather than the pelvis moving relative to a fixed trunk.

Slide 52: ● The pelvis can tilt posteriorly and anteriorly in the sagittal plane around a mediolateral axis.

- When the pelvis tilts and no motion occurs at the lumbosacral joint, the upper body changes its orientation; when this happens, the trunk is said to "go along for the ride."
- The pelvis can depress or elevate on one side in the frontal plane around a vertical axis.
- When the pelvis elevates on one side, it depresses on the other, and vice versa.
- The pelvis can rotate to the right or to the left in the transverse plane around a vertical axis.
- It is possible for the pelvis to move at both hip joints at the same time, resulting in the pelvis changing position relative to both thighs. What happens if the pelvis moves relative to only one hip joint?
  If the pelvis moves relative to only one hip joint, the other thigh stays fixed to the pelvis and "goes along for the ride."

Slide 53: ● When the pelvis moves at both the lumbosacral joint and the hip joints, it changes in position relative to both the spine and the femurs.
- When the pelvis approaches its maximum range of movement at the lumbosacral joint, motion also occurs at the lumbar spinal joints, changing the lumbar spinal curve.

Slide 54: ● Pelvic/spinal movement at the lumbosacral joint is possible within each of the three cardinal planes: **sagittal, frontal, and transverse.**
- Pelvic movements can be understood as the reverse actions of the muscles that cross the lumbosacral joint from the trunk to the pelvis.
- During pelvic/spinal movement in the sagittal plane, anterior abdominal wall musculature tilts the pelvis posteriorly and/or flexes the trunk at the lumbosacral joint.
- Name some of the muscles of the anterior abdominal wall that posteriorly tilt the pelvis and/or flex the trunk at the lumbosacral joint.
  *Such muscles include the **rectus abdominis, external abdominal obliques,** and the **internal abdominal obliques**.*

Slide 55: ● Paraspinal musculature tilts the pelvis anteriorly and/or extends the trunk at the lumbosacral joint.
- Name some of the muscles of the paraspinal musculature that anteriorly tilt the pelvis and/or extend the trunk at the lumbosacral joint.
  *Such muscles include the **erector spinae group, transversospinalis group, quadratus lumborum,** and **latissimus dorsi.***
- During the frontal plane actions of the pelvis and trunk at the lumbosacral joint, the right pelvis is elevated by the same muscles responsible for right lateral flexion of the trunk. Name some of the muscles involved.
  *Muscles involved include the **right erector spinae group**, **right transversospinalis group, right quadratus lumborum,** and **right latissimus dorsi.***

Slide 56: ● During transverse plane actions of the pelvis and trunk at the lumbosacral joint, the same musculature performs both pelvic and trunk actions. Name some of the muscles involved in both right rotation of the pelvis at the lumbosacral joint and the left rotation of the trunk at the lumbosacral joint.

Muscles involved include both left-sided ipsilateral rotators of the trunk (the erector spinae group and left internal abdominal oblique) and right-sided contralateral rotators of the trunk (the right transversospinalis group and right external abdominal oblique).

Ipsilateral means on the same side
Contralateral mean on the opposite side

Slide 57: ● Pelvic/thigh movement at the hip joint can be considered the reverse action of the muscles crossing the hip joint from the pelvis to the thigh. These movements cross three planes: sagittal, frontal, and transverse.

During pelvic/thigh movement in the sagittal plane, anterior tilt of the pelvis at the hip joint and flexion of the thigh at the hip joint are performed by the same anterior muscle group. What muscle group is that?
The flexor muscles of the hip joint move both the thigh upward toward the pelvis and/or the pelvis downward toward the thigh.

- Posterior tilt of the pelvis at the hip joint and extension of the thigh at the hip joint are performed by the same posterior muscle group. What muscle group is that?
  The extensor muscles of the hip joint move both the pelvis downward posteriorly toward the thigh and/or the thigh upward posteriorly toward the pelvis.

Slide 58: ● During pelvic/thigh movement in the frontal plane, the same muscles perform both depression of the right pelvis at the hip joint and abduction of the right thigh at the hip joint. What muscles are these?
The abductor muscles of the right hip joint move both the right thigh laterally up toward the right side of the pelvis and/or the right pelvis laterally down toward the right thigh.

- Elevation of the right pelvis at the hip joint and adduction of the right thigh at the hip joint are performed by the same medial group of musculature. What group is that?
  The hip adductor musculature.
- Note that the pelvis largely moves as a unit, so elevation of the right side of the pelvis depresses the left side of the pelvis. The muscles involved, therefore, are ipsilateral elevators of the pelvis.

Slide 59: ● Pelvic/thigh movement in the transverse plane results from the action of posterior and anterior groups of musculature. The posterior group is often called the lateral rotators of the hip joint. What pelvic action does the posterior group perform?
The lateral rotators perform contralateral rotation of the pelvis at the hip joint (left rotation of the pelvis by right-side musculature). They also perform lateral rotation of the thigh at the hip joint.

- The anterior group is often called the medial rotators of the hip joint. What pelvic action does the anterior group perform?
  The medial rotators perform ipsilateral rotation of the pelvis at the hip joint (right rotation of the pelvis by right-side musculature). They also perform medial rotation of the thigh at the hip joint.
- Medial rotation of the thigh and ipsilateral rotation of the pelvis at the hip joint are reverse actions of the medial rotator of the hip muscles. Similarly, lateral rotation of the thigh and

contralateral rotation of the pelvis at the hip joint are reverse actions of lateral rotator of the hip muscles.

Slide 60: ● The sacral base angle measures the anterior tilt of the sacrum. Because the spinal column sits on the sacral base, any change in this angle affects the posture of the spine. A tilt angle of approximately 30 degrees is considered normal.
- Lumbopelvic rhythm refers to the relationship between the posture and movement of the pelvis and spine.
- The righting reflex refers to the body's instinct to bring the head to a level posture. This is one of the purposes of the spinal column and helps ensure proper balance, hearing, and vision.
- A sacral base angle of 15 degrees, as in Figure 8-15a, is less than normal and results in decreased spinal curvature. A sacral base angle of 45 degrees, as in Figure 8-15c, is greater than normal and results in an increased curvature of the lumbar spine.
- If the sacral base were perfectly level, the spine could be totally straight and the head would be level. Because the sacral base tilts, the spine, obeying the righting reflex, curves to bring the head to a level posture.

Slide 61: none

Slide 62: none

Definitions: **close-packed position** The joint position in which articulating bones have their maximum area of contact with each other.

Loose packed: a point in the range of motion of a joint at which articulating surfaces are the least congruent and the supporting structures are the most lax. Any movement away from the close-packed position takes a joint into the **loose-packed position** in which the area of contact and joint stability is reduced. Resting position of joints.

Open chain: when the chain is open, a twisting force at one end causes rotation at the other end. As it rotates it "untwists" the chain and so no torsional stress occurs. When the hand is free to move, rotation of the shoulder will produce a turning of the hand. The upper limb is acting an open chain.

Closed chain: if the end of the chain is fixed, as in a push up, the chain will not be able to "untwist". Any rotation at the shoulder produces tortional stress across the joints between the shoulder and the hand.

Slide 63: ● The femur and pelvic bone meet in the ball-and-socket hip joint formed by which parts of the femur and pelvis?
The head of the femur articulating with the acetabulum of the pelvic bone forms the hip joint's ball-and-socket joint.
- All three bones of the pelvic bone (the ilium, ischium, and pubis) compose the acetabulum.
- The hip joint is a synovial joint of the subtype ball-and-socket, with diarthrotic function of the subtype triaxial.

- The socket of the hip joint is very deep and provides excellent stability. How does it compare to a shallower socket like the glenoid fossa of the shoulder joint?
  The deepness of the hip socket joint provides for better stability but less mobility than a shallower socket, such as the socket in the shoulder joint.
- Within the sagittal plane, the hip joint allows the axial movements of flexion and extension around a mediolateral axis. In the frontal plane it allows abduction and adduction around an anteroposterior axis. Within the transverse plane it allows medial rotation and lateral rotation around a vertical axis.
- Reverse actions of the pelvis at the hip joint are anterior tilt and posterior tilt in the sagittal plane, depression and elevation in the frontal plane, and right rotation and left rotation in the transverse plane. See Lesson 8.1 for review of these reverse actions.

Slide 64: ● Describe open- and closed-chain activity.
Chain activities involve linked kinematic elements (such as bones). An open chain allows movement of the distal element. A closed chain does not, requiring that the proximal element move instead.

- In a very common closed-chain activity, the foot is planted on the ground, fixing its distal end. Within a closed chain, any muscle activity will be a reverse action, meaning the proximal body moves relative to a distal body, reversing the usual action. Instead of the planted foot moving, the leg will move at the ankle joint, or the thigh at the knee joint, or the pelvis at the hip joint.
- Flexion and extension of the thigh at the hip joint are axial movements within the sagittal plane around a mediolateral axis.
- In Figure 8-17a and Figure 8-17b, the muscles of the hip joint move the distal thigh relative to a more fixed pelvis. What kind of chain action is this?
  The distal thigh's freedom of movement makes the depicted flexion and extension open-chain actions.
- If action here were closed-chain, the pelvis would tilt anteriorly and posteriorly in the sagittal plane relative to a fixed distal thigh.
- The abduction and adduction movements shown in Figure 8-17c and Figure 8-17d also illustrate open-chain activity in which the distal thigh moves freely relative to the proximal thigh.
- Abduction and adduction of the thigh at the hip joint are axial movements within the frontal plane around an anteroposterior axis.
- Medial and lateral rotations of the thigh at the hip joint are axial movements around a vertical axis within the transverse plane.
- If the distal thigh were fixed (creating a closed chain), what pelvic movement at the hip joint would be possible in this transverse plane?
  The closed chain created by a fixed distal thigh would allow only a reverse action, which in the transverse plane means right and left rotation of the pelvis at the hip joint.

Slide 65: ● Table 8-2 lists the average ranges of motion of the thigh moving relative to a fixed pelvis at the hip joint.

- The closed-chain pelvic movements listed in Table 8-1 describe the reverse actions of the pelvis at the hip joint.
- Note that the average ranges of motion for these open-chain actions of the hip joint (Table 8-2) are generally larger than the average ranges of movement observed in closed-chain actions listed in Table 8-1. This is because the spine is not allowed to go along for the ride in the actions listed in Table 8-1.

Major Ligaments of the Hip Joint:
Fibrous joint capsule
    Iliofemoral ligament
    Pubofemoral ligament
    Ischiofemoral ligament
Ligamentum teres

- The twisting of the ligaments of the hip joint visible in Figure 8-18 happens in utero when the femur shaft rotates medially. This twisting causes the ventral surface of the thigh to face posteriorly instead of anteriorly. Importantly, this means that flexion of the leg at the knee joint is a posterior rather than anterior movement.
- The ligamentum teres runs from the internal surface of the acetabulum to the femur head. How does its function differ from the other ligaments?
  Rather than adding stability, the ligamentum teres provides a conduit for blood vessels and nerves to the femoral head.
- Large muscle groups cross the hip joint. Name them.
  Anterior muscles include the iliopsoas, tensor fasciae latae, rectus femoris, sartorius, and the further anterior hip joint adductors. Posterior muscles include gluteals, hamstrings, and the adductor magnus. Medial muscles include the hip joint adductor group. Lateral muscles include the gluteals, tensor fasciae lata, and the sartorius.

Slide 66: ● The head, neck and shaft that compose the femur do not lie in a straight line. Two femoral angulations exist between them, measured by the angle of inclination and the angle of torsion.

- The angle of inclination is the angulation of the femoral head/neck relative to the shaft within the frontal plane. While a normal adult angulation approximates 125 degrees, at birth the angle approximates 150 degrees. What reduces this angle?
  The stress of weight bearing decreases the femur's angle of inclination as the child ages.

Slide 67: ● There tends to be a rhythm to how the femur of the thigh and the pelvis move. When the actions of the thigh and the pelvis are coupled to allow a greater elevation of the foot in the air, this coordination of movement is known as femoropelvic rhythm.

- To kick a ball, the right thigh moves at the hip joint up to its maximum 90 degrees. The coupled action of femoropelvic rhythm increases this range by tilting the pelvis posteriorly at the left (contralateral) hip joint, thus providing a stronger follow-through for the kick. How does the ballet dancer increase her range of motion?
  Femoropelvic motion couples right thigh extension at the hip joint with an anterior tilt of the pelvis at the left (contralateral) hip joint.

Slide 68: none

Slide 69: ● Why is the knee joint called a joint complex?
The knee joint is called a complex because its capsule contains more than one articulation.
- The knee joint's primary articulation is between the tibia and the femur, known as the tibiofemoral joint. Generally when the context is otherwise not made clear, the term knee joint refers to the tibiofemoral joint.
- At the patellofemoral joint, the patella articulates with the femur within the same joint capsule as the tibiofemoral joint.
- The tibiofemoral joint is classified as a synovial modified hinge joint. Its functional classification is diarthrotic biaxial.
- Some sources, however, classify the tibiofemoral as a double condyloid joint: the medial condyle of the femur meets the medial plateau of the tibia as one condyloid joint, while the lateral condyle meets the lateral plateau of the tibia as another condyloid joint.
- The tibiofemoral joint allows the axial movements of flexion and extension around a mediolateral axis within the sagittal plane.
- It also allows the axial movements of medial and lateral rotation around a vertical axis within the transverse plane.
- Medial and later rotation, however, can only occur if the tibiofemoral joint is in flexion. A fully extended tibiofemoral joint cannot rotate.

Slide 70: ● Figure 8-23a and Figure 8-23b show flexion and extension of the knee joint, respectively. Name the specific characteristics of these tibiofemoral movements.
Flexion and extension of the tibiofemoral joint are axial movements around a mediolateral axis within the sagittal plane.
- Lateral rotation and medial rotation of the leg at the knee joint are possible only if the knee joint is flexed (and the thigh is fixed). Likewise, when the knee joint is flexed and the leg is fixed, the thigh can rotate at the knee joint. *Explain why these two are considered reverse actions.*
Medial rotation of the leg at the knee joint is equivalent to lateral rotation of the thigh at the knee joint. Similarly, lateral rotation of the leg at the knee joint is equivalent to medial rotation of the thigh at the knee joint.
- Ligaments providing important stability to the knee joint are often injured. Why?
Powerful forces are transmitted to the knee joint, which also performs a weight-bearing role. However, the shapes of the bones of the knee joint provide little stability.
- The capsule of the tibiofemoral joint extends from the distal femur to the proximal tibia and includes the patella. Although lax, it is reinforced by many ligaments, muscles, and fascia.

Slide 71: ● The medial and lateral collateral ligaments are found on both sides (lateral means side) of the tibiofemoral joint. Why are they important?
The two collateral ligaments importantly limit frontal plane movements of the bones at the knee joint.

- The medial collateral ligament attaches from the femur to the tibia and limits frontal plane abduction of the leg at the knee joint.
- The lateral collateral ligament attaches from the femur to the fibula and limits frontal plane adduction of the leg at the knee joint.
- The anterior and posterior cruciate ligaments cross each other (cruciate means cross) and limit sagittal plane translation movement of the bones of the knee joint. Together the various fibers of these ligaments can resist the extremes of every motion at the knee joint.
- The anterior cruciate ligament attaches from the anterior tibia to the posterior femur, where it becomes taut at the end of the range of extension of the knee joint.
- The posterior cruciate ligament attaches from the posterior tibia to the anterior femur, where it becomes taut at the extreme end range of flexion of the knee joint.
- When learning the cruciate ligaments it can be useful to "think tibia": the anterior cruciate attaches to the anterior tibia (and posterior femur) and limits anterior glide of the tibia (and posterior glide of the femur). Similar reasoning applies to the posterior cruciate ligament.
- Which is the most commonly injured ligament of the knee?
  The anterior cruciate ligament is the most commonly injured. "Cutting" in sports (a combination of forceful extension and rotation with the foot planted when changing direction while running) is often to blame for anterior cruciate tears.

Slide 72: ● The major anterior muscles of the knee joint are those of the quadriceps femoris group; the gluteus maximus and tensor fasciae latae also aid extension of the knee joint.
- The major posterior muscle group is the hamstring group. The heads of the gastrocnemius are also located posteriorly. These muscles flex the knee joint.
- No muscles move the knee joint medially in the frontal plane, but the sartorius, gracilis, and semitendinosus stabilize the knee joint's medial side.
- No muscles move the knee joint laterally in the frontal plane either, but the iliotibial band helps stabilize the knee joint's lateral side.
- Two menisci (medial and lateral) are located within the knee joint on the tibia. Crescent-shaped and fibrocartilaginous, they absorb approximately half the weight-bearing force transmitted through the knee. They also increase the knee joint's congruency and stability.
- The screw-home mechanism describes the rotation of the knee joint that occurs while completing its final 30 degrees of extension. This action helps to lock the knee joint and increase stability. If the thigh is fixed, the leg will rotate laterally at the knee joint. If the leg is fixed, the thigh will rotate medially at the knee joint.

Slide 73: ● The posterior articular surface of the patella has two facets. Describe their motion.
The medial facet moves along the medial condyle of the femur; the lateral facet moves along the lateral condyle of the femur.
- The articular surface of the patella has the thickest cartilage of any joint in the body, allowing it to withstand the compressive force of the patella against the femur, as well as the stress that can result if the patella does not track perfectly along the intercondylar

groove of the femur. Breakdown of this cartilage, which is common, is called patellofemoral syndrome. It is often repaired with arthroscopic surgery.

- The patella allows superior and inferior gliding (nonaxial) movements along the femur; during this movement the patella is said to be tracking the femur.
- Even though the closed-packed position of the knee (tibiofemoral) joint is full extension, the patella itself is most stable when the knee joint is in full flexion.
- What is the major purpose of the patella?
  The major purpose of the patella is to act as an anatomic pulley, changing the line of pull and increasing the leverage and force that the quadriceps femoris muscle group exerts on the tibia. Without a patella, the muscles would lose about 20% of their strength at the knee joint.

Slide 74: ● Why is a slight genu valgum at the knee joint normal?
Slight genu valgum is normal because the femur slants inward and, in consequence, meets the vertical tibia at an angle.

- A genu valgum angle greater than 10 degrees is excessive and produces knock-knees. A genu varum angle at the knee joint is called bowleg. An excess in either direction increases stress and can damage the knee joint.
- Various problems of the foot, knee joint, and hip joint can all contribute to an increased genu valgum.
  The frontal-plane angulation called the Q-angle is so named because it measures the lateral angle of pull of the quadriceps femoris group on the patella. A normal Q-angle measures 10 to 15 degrees. Men typically measure 10 degrees, but because the female pelvis is wider, women measure nearer to 15 degrees.
- What is the effect of an increased Q-angle?
  An increased Q-angle pulls the patella laterally, causing it to ride against the lateral side of the intercondylar groove, which could damage the cartilage of the articular posterior surface of the patella.
- Normal full extension of the knee joint produces a hyperextension of 5 to 10 degrees. Why?
  Two factors explain why the knee joint hyperextends into the sagittal plane at full extension. The shape of the tibial plateau slopes slightly posteriorly. And the center of a person's body weight when standing falls anterior to the knee joint. Resistance is provided by the passive tension of soft tissue structures of the posterior knee joint. When this resistance is insufficient, genu recurvatum results.
- Genu recurvatum describes the (hyper)extension of the knee joint beyond 10 degrees in the sagittal plane.

Slide 75: ● The proximal tibiofibular joint is between the lateral condyle of the tibia and the head of the fibula. The middle tibiofibular joint is formed by the interosseus membrane that unites the shafts of the tibia and fibula. The distal tibiofibular joint is created by the articulation of the medial side of the lateral malleolus of the fibula and the fibular notch in the distal tibia.

- What type of motion do tibiofibular joints allow?

The tibiofibular joints allow nonaxial superior and inferior glide motions of the fibula relative to the tibia.

- The interosseus membrane that unites the shafts of the tibia and fibula allows the joined bones to grip the talus of the ankle joint between them, making the middle tibiofibular joint vital to the stability of the ankle joint. It also transfers the force of muscles pulling on the fibula to the tibia, moving the leg at the knee joint.
- Tibial torsion describes the twisting of the shaft of the tibia, which causes the distal tibia and proximal tibia to face in different directions, with the distal tibia facing somewhat laterally compared to the proximal tibia. What effect does tibial torsion have on the ankle joint?
  As a result of lateral tibia torsion, motions at the ankle joint do not occur exactly within the sagittal plane but in an oblique plane instead.

Slide 76: ● The joints of the lower extremity discussed in Lesson 8.4 include the talocrural (ankle) joint, the tarsal joints, the tarsometatarsal joints, the intermetatarsal joints, the metatarsophalangeal joints, and the interphalangeal joints.

- How are the names for the metatarsophalangeal and interphalangeal joints often abbreviated?
  The metatarsophalangeal joints are often referred to as the MTP joints, and the interphalangeal joints are often referred to as the IP joints.
- The foot is defined as everything distal to the tibia and fibula. The bones of the leg articulate with the foot at the talocrural ankle joint.
- The bones of the foot can be divided into tarsals, metatarsals, and phalanges.
- The carpal bones are known as the wrist bones. What bones are similarly known as ankle bones?
  The tarsal bones are known as the ankle bones.

Slide 77: ● The foot requires great stability to support the weight of the body above it and to absorb the shock of the ground beneath. It also must be rigid enough to propel the body through space by pushing off the ground.

- Flexibility is an antagonist concept to stability. Why must the foot also be flexible?
  Flexibility allows the foot to adapt to the uneven ground surfaces it encounters.
- To meet these divergent demands requires the coordinated functioning of an entire complex of joints in the ankle region.
- To detect pes cavus (excessive arch) or pes planus (decreased arch) simply observe a client's arch by taking an anterior view of the foot in a weight-bearing position.
- From a posterior view, a bowing of the calcaneal (Achilles) tendon will indicate a dropped arch.
- You can also evaluate arches by spreading a small amount of oil on the foot and having the client leave a footprint on construction paper.
- The implications of unequal arches in the feet are many. For one, the consequent height differential in the lower extremities can laterally tilt the pelvis, causing scoliosis in the spine.

Slide 78: none

Slide 79: ● The talocrural joint is located between the dome shape of the talus and the rectangular cavity formed by the distal tibia and fibula. The image of a wrench gripping a nut approximates the structure of the ankle joint. Explain the nut/wrench analogy.
If comparing the ankle joint to a wrench gripping a nut, the malleoli of the tibia and fibula would be the jaws of the wrench and the talus would be the nut.

- Classify the structure and function of the talocrural (ankle) joint.
  The talocrural joint is structurally classified as a synovial hinge joint.
  The talocrural joint is functionally classified as a diarthrotic uniaxial joint.
- The talocrural joint allows dorsiflexion and plantarflexion (axial movements) around a mediolateral axis within the sagittal plane.
- However, because of the twisting of the tibia known as tibial torsion, motion happens in an oblique plane. This motion is often labeled triplanar, which can be misleading, as triplanar indicates motion across all three cardinal planes. The talocrural joint, however, is uniaxial: it moves in one oblique plane around one oblique axis.

Slide 80: ● The terms dorsiflexion and plantarflexion are used to avoid confusion regarding which ankle joint motion is flexion and which is extension. Technically, flexion is plantarflexion because that is the direction of flexion from the knee joint and further distal.

- What movement is possible at the ankle joint if the foot is fixed in place?
  Moving the ankle joint with the foot fixed produces a reverse action: in this case, dorsiflexion and plantarflexion of the leg in the sagittal plane at the talocrural joint.

Slide 81: Figure above shows most of the bursae, retinacula, and tendon sheaths of the ankle joint region. The retinacula hold down the tendons that cross the ankle joint, preventing the tendon action called bowstringing. Why are tendon sheaths important to the talocrural joint?
Tendon sheaths, found around most tendons that cross the ankle joint, minimize friction between the tendons and the underlying bony structures.

Slide 82: ● Describe the structural and functional classification of the subtalar tarsal joint.
The subtalar tarsal joint is classified structurally as a synovial joint. Its functional classification is diarthrotic uniaxial.

- Because it allows movement across all three cardinal planes, the subtalar joint is often called triplanar. However, its motion is in one oblique plane around one axis. So, while it is triplanar, it is nonetheless uniaxial (like the talocrural joint described in Section 8.18).
- Pronation and supination of the foot are axial movements in an oblique plane around an oblique axis.
- During closed-chain activity, when the foot is planted on the ground, reverse action will medially and laterally rotate the leg at the subtalar joint.
- The sinus tarsus, a large cavity between the talus and calcaneus, is visible from the lateral side (show in Figure on the previous slide).

Slide 83: ● In Figure 8-40a, the foot pronates at the subtalar joint. This oblique plane movement comprises three cardinal plane components: eversion, dorsiflexion, and abduction of the foot.
- In Figure 8-40b, the foot supinates at the subtalar joint. This oblique plane movement comprises three different cardinal plane components: inversion, plantarflexion, and adduction of the foot. (The red cylinder represents the axis of motion.)
- Figure 8-40c illustrates the frontal plane components of inversion and eversion. (The red dot represents the axis of motion.)
- Figure 8-40d illustrates the sagittal plane components of dorsiflexion and plantarflexion. (The red dot represents the axis of motion.)

Figure 8-40e illustrates the transverse plane components of abduction/adduction. (The red cylinder represents the axis of motion.)

Slide 84: ● The MTP joints are located between the heads of the metatarsals and the bases of the proximal phalanges of the toes. They are numbered from the medial side to the lateral side as MTP joints #1-5.
- Name the joint structure classification and the joint function classification of the MTP joints.
  The MTP joints are synovial joints (subtype: condyloid) and are diarthrotic (subtype: biaxial).
- These illustrations show flexion and extension of the toes at the MTP and IP joints.
- Flexion and extension of the toes at the MTP joints are axial movements. In what plane and around what axis to these movements occur?
  They occur in the sagittal plane around a mediolateral axis.

Slide 85: ● Figure 8-46 illustrates the fibrous capsule, collateral ligament, and plantar plate of the MTP joint. These structures are also illustrated for the PIP and DIP joints.
- What is hallux valgus and what can it result in?
  Hallux valgus is a deformity of the big toe in which the big toe deviates laterally at the MTP joints. It also often involves a medial deviation of the first metatarsal and causes increased stress resulting in inflammation of the bursa located there. This can eventually result in fibrosis and excessive bone growth on the medial side of the first metatarsal's head which is called a bunion.
- The interphalangeal joints pedis are located between the head of the more proximal phalanx and the base of the more distal phalanx of the toes.
- How are the interphalangeal joints of the foot distinguished from the interphalangeal joints of the hand?
  The words pedis (denoting foot) and manus (denoting hand) are used to distinguish between these interphalangeal joints.
- The big toe has only one IP joint, but toes #2-5 each have two IP joints (a proximal interphalangeal [PIP] joint and a distal interphalangeal [DIP] joint).