1. Plan of Action:

In this guide you will learn to identify these structures:

- Cervical vertebrae: with an emphasis on C1 and C2 (the atlas and axis)
- Thoracic vertebrae: with an emphasis on their rib facets
- Lumbar vertebrae
- Sacral vertebrae: fused into a single sacrum
- Coccygeal vertebrae: fused into a single coccyx

2. Spine Overview

The spine is the central element of the locomotor skeleton, acting as a partly rigid, partly flexible link between the upper and lower limbs. The spine also provides a bony tube that protects the spinal cord from injury.

The spine is made up of 5 types of vertebrae, identified according to region and morphology. These are cervical (neck), thoracic (trunk), lumbar (lower back), sacral (pelvis), and coccygeal (pelvis). The different vertebral types are similar in general appearance, but each type exhibits a unique morphology that impacts its functional properties.

Most vertebrae are comprised of:

1. a **body**: note that C1 has lost its body (see below).

2. A **vertebral arch** (also called the neural arch): made of **pedicles** (wall) and **laminas** (roof) that form a vertebral canal (also called neural canal) within which lies the spinal cord.
(3) **processes**: on the dorsal portion of most vertebrae that provide sites for muscle attachment, articulation with other vertebrae and sometimes articulation with ribs.

(a) **Muscular processes**: The **spinous process** projects dorsally from the intersection of the two laminas. The **transverse process** projects laterally (and a little dorsally in thoracic vertebrae) from the intersection of the lamina and pedicle. Both provide attachment sites and leverage for epaxial and hypaxial muscles. In cervical vertebrae, the fusion of a “costal” process and transverse process forms the transverse foramen.
(b) *Articular processes:* Vertebrae articulate with one another in two ways. First, they articulate with each other at the body, where an articular disc separates them. The articular disc allows movement and also cushions loads. Second, vertebrae form synovial joints at the pedicle and lamina junction, called articular processes. There are two pairs of *articular processes* or zygapophyses on each vertebra. One pair lies cranially (the *superior articular processes*, or prezygapophyses) and one pair lies caudally (the *inferior articular processes*, or postzygapophyses). The prezygapophyses of one vertebra articulate with the postzygapophyses of the vertebra that lies cranial to it.

3. **The spine by region**

3.1 **Cervical region:**

There are seven cervical vertebrae. The first cervical vertebra (called the atlas) articulates with the occipital condyles on the base of the skull. Cervical vertebrae are distinct because:

(1) The body of the cervical vertebra is small in proportion to the vertebral foramen. Vertebral body size generally increases from cranial to caudal but cervical vertebrae are especially small in this regard (due to large neural canal at this location).

(2) The transverse processes of cervical vertebrae are small and project laterally. The transverse processes of cervical vertebrae 1-6 are said to contain the **transverse foramen.** This foramen forms through incomplete fusion of costal and mammillary processes. These important foramina allow passage of and protect the vertebral arteries.

(3) The spinous processes are slender and bifid at their distal ends in C1-C5 (C6).
The atlas (C1) and axis (C2) differ substantially from the other five cervical vertebrae. The atlas (C1) has no body. The body has been “transferred” to C2 where it forms the dens, or odontoid process.

The superior articular processes of C1 are very large, for articulation with the occipital condyles of the skull.
It is worth noting that C7 is the transitional vertebra between cervical and thoracic vertebrae. It does not have a spinous bifurcation and has a long spinous process that is a palpable point in the neck.

### 3.2 Thoracic region

Thoracic vertebrae have articular facets for the ribs. Each rib articulates with two adjacent vertebrae so most thoracic vertebrae have articular facets for two ribs. One rib articulates with the thoracic facet at the junction of the vertebral body and the pedicle. Another articular facet for the same rib is positioned on the most lateral portion of the transverse process, which projects laterally and dorsally. The second articulating rib joins the vertebra at the dorsolateral margin of the caudal end of the vertebral body.
3.3 Lumbar region

The lumbar vertebrae are generally the largest of the entire vertebral column because they bear the most weight. Lumbar vertebrae differ from thoracic vertebrae in:

(1) Lacking articulations for the ribs
(2) Having a robust, squared spinous processes
(3) The orientation of the articular processes. The articular processes of the lumbar vertebrae tend to be oriented in a parasagittal plane, and therefore movement in the lumbar region is predominantly restricted to flexion and extension of the spine.
(4) Having small vertebral foramen.

3.4 Sacral region:
There are typically five sacral vertebrae that are fused to form the sacrum. However, sacral number can vary, some sacral vertebrae are free and are considered “lumbarized”, and sometimes a lumbar vertebra is fused and considered “sacralized”. The sacrum and the innominate bones form the pelvis.

There are no intervertebral discs between sacral vertebrae since adjacent vertebral bodies and zygapophyses are fused. Four transverse lines mark the positions that the disks would take if these were true vertebrae. Cranially, the sacrum articulates with the last lumbar vertebra. The sacrum articulates distally with the first coccygeal vertebra.

3.5 Coccygeal region:

Coccygeal vertebrae are highly variable in shape and can contain three to five fused segments to form the coccyx. These vertebrae have articular and transverse processes but lack in laminae, pedicles, and spinous processes. The coccyx may fuse with the sacrum later in life. The coccyx is an important attachment for muscles of the pelvic floor.