Lesson 15

Lesson Outline:

Exercise #1 - Basic Functions
Exercise #2 - Phylogenetic Trends
Exercise #3 - Case Studies to Compare

Objective:

Apply what you have learned to answering these questions

◊ **References:**

Chapter 10: 200-232

◊ **Reading for Next Lesson:**

Chapter 9: 162-198

Appendicular Skeleton

Throughout the course what you need to master is an understanding of:

1)the form and function of structures,
2) the phylogenetic and ontogenetic origins of structures, and
3) the extend to which various structures are homologous, analogous and/or homoplastic.

Exercise #1 List the basic functions of the axial skeleton :

The appendicular skeleton is not used *so much* for protection, as the skull and vertebral column are.
It *primarily* subserves the roles of:

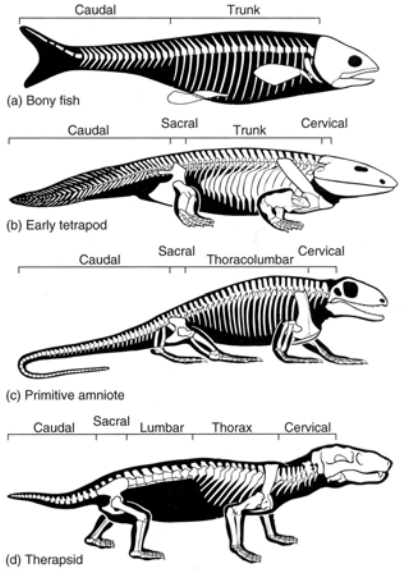
- support
- provision of attachment sites for muscles
- provision of levers for locomotion

The biggest differences are between aquatic and terrestrial animals since both the means of support and the style of locomotion differ tremendously.

Within each group, however, there are tremendous differences

Fishes:	lift for cruising	Tetrapods:	running
	paddling, sculling		digging
	some thrust but most		swimming
	from the tail		flight
	maneuvering		gliding, parachuting

Exercise #2 Describe the evolutionary trends that we see in the appendicular skeleton - from the fishes to the birds and mammals:



Fins:
The finfold theory maintains that paired fins arose within bilateral ventrolateral folds in the body wall.

The fins then became stiffened by a series of endoskeletal pterygiophores (the basals and the radials, developing from mesenchyme within the folds).

The living agnathans have secondarily lost paired fins

The first of the living vertebrates to exhibit fins are the Chondrichtyes. The paired fins provide stability and act to produce lift and support in the water.

In the Actinopterygians (ray finned fishes) - the fins serve

mainly for stabilization and for close maneuvering, they are not needed for lift.

The Sarcopterygian fishes (lobe finned fishes), possess extra internal bony elements in the fin as well as muscles external to the body wall, projecting along the limb itself, features that approach those of early tetrapods.

Thus the trend was:

-fins to stabilize the body
-girdles to stabilize the fins
-addition of dermal bone in the pectoral region and connection to the skull for extra stability
- adaptations to increase maneuverability
-addition of extra internal elements in the fin and muscles external to the body wall projecting along the fin for more maneuverability

The overall trend is one of an increasing role in maneuvering

Limbs

The fins are replaced with digits.
Limbs become stronger and more robust, and more completely ossified - for support and locomotion.

Most of the adaptations that one sees in the design of limbs in terrestrial vertebrates are associated with efficiency and/or speed of locomotion.

Most of the adaptations that one sees in the design of limbs in terrestrial vertebrates are associated with efficiency and/or speed of locomotion.

Elbows and Knees and Ankles and Wrists
Limb Posture
Digit Orientation
Cursorial Locomotion
Foot Posture
Position of limb Muscles
Reduction in Number of Digits

In marine mammals that are highly adapted for swimming, the limbs may be drastically reduced.

Many birds swim using their forelimbs as flippers for generating thrust. In these species, the forelimb is usually enlarged and strengthened.

In other birds, it is the hindlimb that is used for swimming and here the most notable adaptations are in the shape of the foot for increasing surface area to generate thrust.

Pectoral Girdle
The girdles are believed to have developed to stabilize the fins.

Next, the paired basal components of the pectoral and pelvic girdles become extended and fuse in the midline of the body. They are embedded in body wall muscle and are not attached to the vertebral column

Then the pectoral girdle incorporates dermal bones. The elements from each side meet dorsally where the dermal elements are attached to the back of the skull producing a strong platform for muscle attachment and support of the fins.

Thus the pectoral girdle looses this connection in tetrapods. Here it is braced ventrally to either the sternum or to itself where elements of the girdle meet in the ventral midline in all vertebrates.

In the pectoral girdle, the dermal bones become reduced (or lost completely).

In many the clavicles and interclavicle persist.

The endochondral bones tend to become larger and more prominent.

Pelvic Girdle
The pelvic girdle is composed only of endochondral bone. It arose from the pterygiophores

It tends to be braced only to itself in the ventral midline in fishes but also to the vertebral column in tetrapods.

In most fishes it is a single element but in tetrapods, it consists of three bones (pubis, ilium, ischium) and is attached to the vertebral column via the ilum..

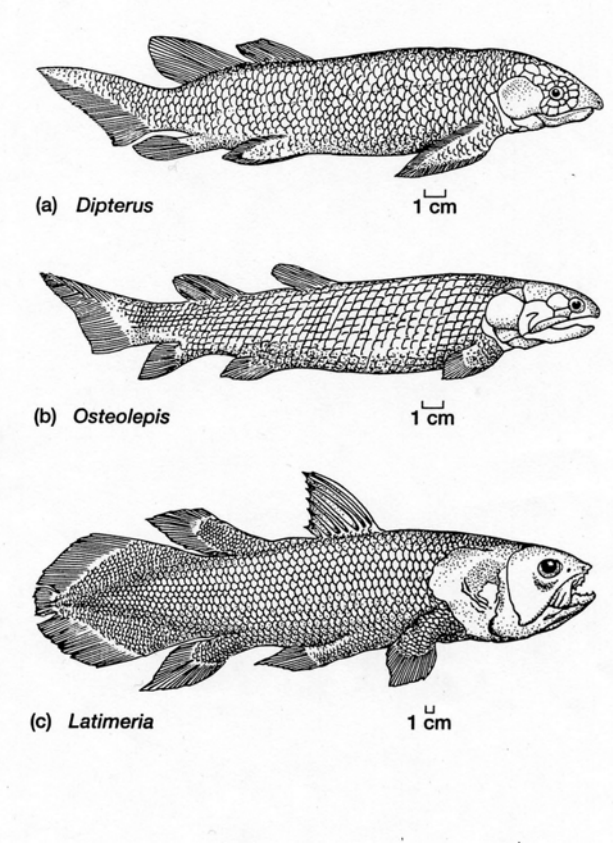
In birds, all three bones become fused into the inominate bone.

<u>Exercise #3</u> – Comparisons – For the following structures:

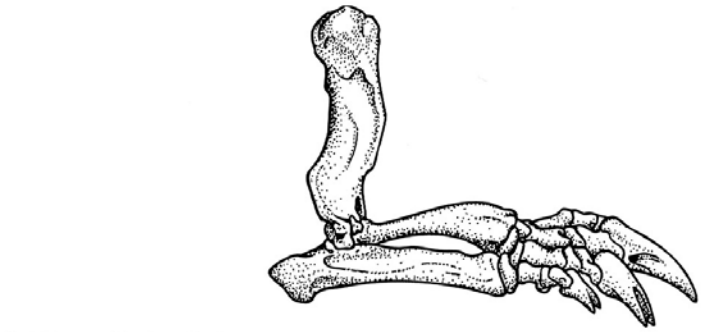
Case 1
What are the different functions of

a)Median fins

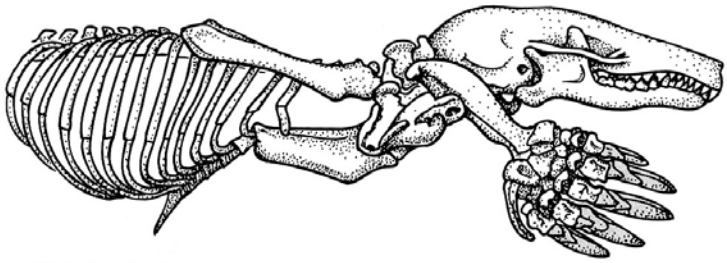
b)The different types of caudal fins



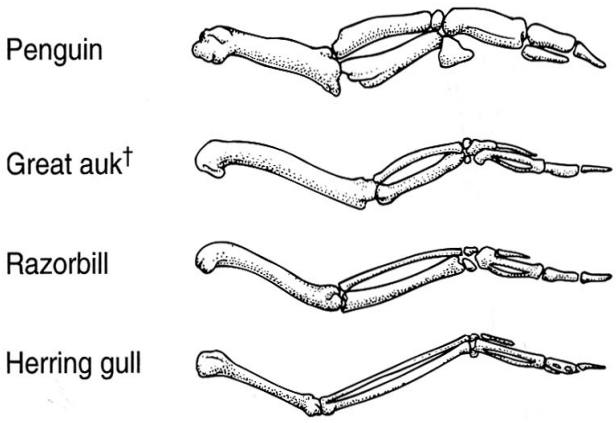
Case 2
How do the differences you see affect function?



(a) Pangolin forelimb



(b) Mole forelimb



Case 3

1) state whether they are homologous, analogous and/or homoplastic.
2) what their function is.
3) what they develop from and what they have evolved from.