# SEGMENTATION 

**Read Chapter 7 in Chapman.**

Adult Insectan Body - 3 body regions or tagma
1. head - prostomium + 4-6 body segments.
2. thorax - 3 segments - prothorax, mesothorax, and metathorax.
   pterothorax - in winged insects it is a fusion of the mesothorax and the metathorax.
3. abdomen - 11 segments + periproct.

Secondary divisions - sclerites do not delineate internal divisions.

**PRIMARY SEGMENTATION**
- This is the type of segmentation found in annelids, soft bodied insects, and larvae of many holometabolous insects such as a caterpillar.

In this type of segmentation the body wall of the organism is still fairly flexible and the body of the organism is usually in the form of many undifferentiated annular rings.

**[SEE FIG. 36 - TEXT; AND HANDOUT FIG. 7]**
**[DRAW FIGURE OF PRIMARY SEGMENTATION]**

There are infoldings of the integument between the metameres called the intersegmental fold. Externally this fold is evident by a depressed line called the intermetameric suture. These infoldings serve as points of articulation and/or internal ridges for the attachment of longitudinal muscles.

As such each individual muscle is completely confined within a single metamere and therefore is said to be intrasegmental in position.

There is much evidence that this is the primitive condition and so it is called primary segmentation.

As the muscles contract that metamere becomes shorter and bulges at the middle. This allows the organism to move about. If the muscles on one side of the organism contract, but not on the other then the organism's body will bend to that side.

This type of segmentation is satifactory for soft bodied organisms, but as insects evolved sclerotized integument it would have become quite difficult for the insect to move.

Also, the development of strong, dorsal apodemes for muscle attachment was advantageous especially in the metameres involved with the flight mechanism.

Apodeme - A chitinous ingrowth of the exoskeleton to which the muscles are attached.

**SECONDARY SEGMENTATION**
So, the primary metameric infoldings or primary sutures on which the longitudinal muscles were attached became sclerotized to form the above apodemes.

These primary sutures because of the sclerotization could no longer serve as a point of articulation, and a secondary point of articulation developed anterior to the original primary suture.

This is the condition in most present day insects and is termed secondary segmentation.

**[SEE FIG. 36 - TEXT; AND HANDOUT FIG. 8]**
**[DRAW FIGURE OF SECONDARY SEGMENTATION]**

This secondary point of articulation no longer corresponds with the original point of division between the metameres, and now the muscles have an intersegmental organization.

The sclerotized infolding at the site of the primary division line is the antecosta. The suture on the external surface corresponding to the antecosta is the antecostal suture. Where this suture becomes relatively deep and wide it is termed the antecostal sulcus.

An anterior portion of the metamere preceding the primary suture also becomes sclerotized forming an acrotergite on the tergum and an acrosternite on the sternum.

It is important to note that the acrotergite and the acrosternite are actually derived from the metamere preceding it.

The acrotergite or acrosternite may be a wide flange or a simple narrow ridge.

The anterior edge of the acrotergite or acrosternite is separated from the preceding tergum/sternum by a membranous area that is the articulatory infolding of the secondary intermetameric suture.

Posteriorly, the edge of the antecostal suture joins and becomes confluent with the tergum or sternum of the metamere following the now sclerotized primary suture.

**SPECIALIZED SEGMENTATION OF THE THORAX**

As we have seen the acrotergite and acrosternite of the abdomen have become a part of the metamere following the secondary intermetameric suture. In the thorax, however, the acrosternite may remain as a free sclerite lying between the sternal plates, or it may fuse with the sternum of the metamere preceding the secondary intermetameric suture. **[SEE FIG. 38 - TEXT; AND HANDOUT FIG. 9]**

Since the acrosternite often lies in the membranous area between the sternal plates, it is also referred to as the intersternite.

Sometimes there is also a modification of the tergum in the thorax of winged insects. **[SEE FIG. 39 - TEXT]**. The acrotergites of the 1st abdominal tergum and the metathoracic tergum have expanded anteriorly to the extent that the intermetameric membrane has almost been completely taken over. Also, a secondary membranous suture may develop just behind the antecosta. This isolated plate bearing the antecosta and the site of attachment for the intersegmental muscles is called the postnotal plate.

The antecosta of the ventral region is usually small compared with the antecosta of the tergum. The antecosta of the tergum is referred to as a phragma, while the antecosta of the sternum is referred to as the intersternal apodeme.

Phragma - Extensive internal plate developed from an antecostal ridge, providing attachment for the large longitudinal flight muscles of the mesothorax and the metathorax.

We will see later that an additional ventral apodeme, the sternal apodeme or furca arises from the sternum, and that the intersternal apodeme has a minor function in the thoracic mechanism.

**MORPHOLOGICAL CHANGES RESULTING FROM SECONDARY SEGMENTATION**

1. The primary intermetameric suture in the tergal region has become sclerotized and forms a strong apodeme for muscle attachment.
2. A secondary point of articulation has developed which no longer marks the boundaries of the primitive metameres.
3. The longitudinal musculature has become intersegmental
4. The acrotergite and the acrosternite of the abodmen are now formed for each metamere.

**HOW SECONDARY SEGMENTATION FUNCTIONS IN THE ABDOMEN**
**[SEE FIG. 36 - TEXT; AND HANDOUT FIG. 10]**

Note that the anterior margins of a metamere underlap the tergum of the preceding metamere. This telescoping of metameres is the characteristic organization of the abdominal tagma.

Contraction of the longitudinal muscles may further shorten the length of the abdomen by increasing the overlap of the metameres. The abdomen may also be considerably expanded along its longitudinal plane by an unfolding of the membrane of the intermetameric suture.

The primitive metamere was probably a simple ring, with articulation and longitudinal expansion or contraction occurring only at the intermetameric suture.

Greater flexibility and a mechanism for increasing the volume of the metamere was accomplished with the development of the longitudinal suture. **[SEE HANDOUT FIG. 11]**

Now each metamere was subdivided into a dorsal plate or tergum and a ventral plate or sternum.

The membranous region of the longitudinal suture may become the site of lateral sclerotizations or pleural sclerites for the accommodation of external openings for the respiratory system and for locomotory appendages.

Since the locomotory appendages of the abdomen in most adult insects have disappeared, the lateral or pleural region may only be a simple membrane.

In some insects, the dorsal and ventral aspects of the infolded membrane may become sclerotized forming small oblong plates called abdominal pleurites. A dorsal plate embracing the spiracle of the respiratory system may be referred to as a laterotergite, and a similar ventral plate as a laterosternite. These should not be confused with the pleurites of the thorax as they probably were not derived from basal elements of legs.

In most adult forms, laterotergites and laterosternites either were not evolved or have become fused with the tergum or sternum.