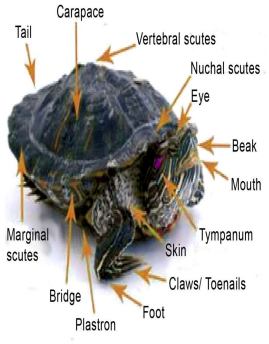
EXERCISE 4

STUDY OF CARAPACE AND PLASTRON OF TURTLE



Structure

4.1 INTRODUCTION

The turtle shell is a highly complicated shield for the ventral and dorsal parts of turtles, tortoises and terrapins which are all classified as "turtles" by zoologists. The turtle shell often completely encloses all the vital organs of the turtle and in some cases even the head. The shell is the most characteristic feature of any turtles/tortoises and is their primary defence mechanism against their predators. The shell has been evolutionarily conserved as it has not changed and has remained same in the past two hundred million years of evolution. The shell is made up of two halves, the dorsal part known as the carapace and the ventral part known as the plastron. Carapace and plastron are fused together at the sides by bony structures called bridges. The shell is basically an extension of the rib cage, which unlike most vertebrates is housed on the “outside” rather than inside the body.

The whole shell of the turtle is made up of numerous small bones which are covered by separate plates of keratin called scutes. As the turtles grows, extra layers of keratin are added underneath the existing layer, forming “growth rings”. “Growth rings” tell us approximately how many spurts of growth the turtle has had. Abundant vegetation means more food, which relates to more growth while sparse vegetation due to extreme climatic conditions would mean little food, leading to little or no keratin growth.

Objectives

After completing this laboratory exercise you should be able to:

- distinguish between carapace and plastron,

- describe the charactersitc features of carapace and plastron, and
- draw and label carapace and plastron.

4.2 MATERIAL REQUIRED

1. Specimens/diagrams/models/photographs of carapace and plastron of a turtle
2. Laboratory manual of the laboratory course BZYCL-134
3. Practical Notebook
4. Hand lens
5. Pen, Pencil, eraser and ruler

4.3 STUDY GUIDE

In order to perform your experiments satisfactorily you should read in advance the present laboratory exercises given in the lab manual of the course BZYCL-134.

In the lab present you will study the salient morphological features of carapace and plastron by observing specimens/drawings/models/photographs.

You are also expected to draw in your practical notebook the labeled diagrams of carapace and plastron which you have studied during this lab exercise. You are required to consult the Laboratory manual while doing your lab exercise.

4.4 FEATURES OF TURTLE SHELL

Shell of a turtle

1. The shell of the turtle is an important structure, not just because of the obvious protection it provides for the animal, but also as an identification tool. The shell of the turtle consists of both skeletal and dermal bones, which indicates that the complete enclosure of the shell probably evolved by including dermal armor into the rib cage. Figure 4.1 a & b shows a photo of a live turtle and an empty turtle shell.
2. The shape of the shell of turtles differs in each species, and this difference is related to habitat. The carapace of shells of most aquatic turtles are generally flatter, allowing them to move faster through the water. Terrestrial turtles more commonly referred to as tortoises, on the other hand, have carapaces that are dome-shaped.
3. The turtle shell is made up of numerous bony elements, generally named after similar bones in other vertebrates, and a series of keratinous scutes which are also uniquely named.

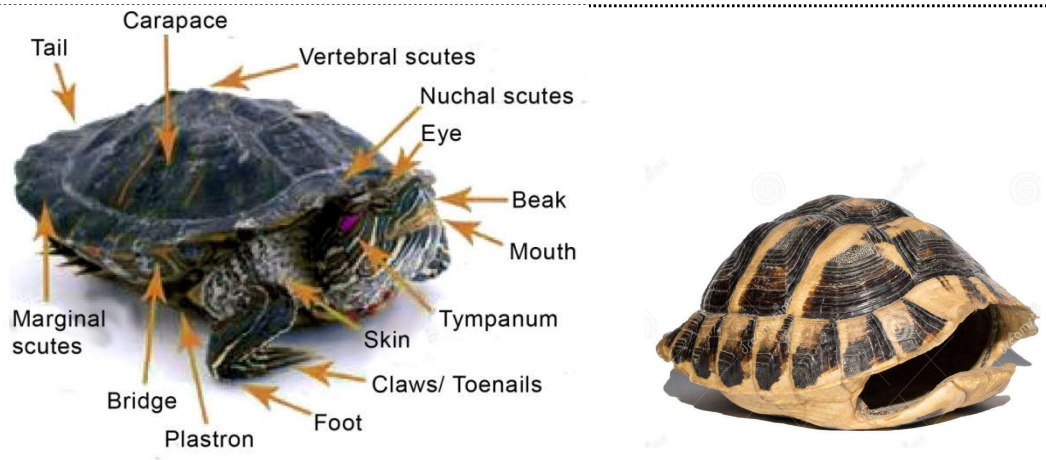


Fig. 4.1: Photographs of: a) Turtle; and b) empty shell of a turtle.

4. The shell of a turtle has the three following parts (Refer again to Fig. 4.1 a & b):

   i) Carapace which forms the upper dorsal part of the shell;

   ii) Plastron which is the lower part of the shell; and

   iii) Bridge which is a line of bone that extends between the fore and hind limbs. It connects the plastron to the carapace. The actual suture between the bridge and the plastron is called the anterior bridge strut.

5. Some turtles and tortoises can completely close their shell, giving them additional protection. Box turtles (hence their name) have a hinge across the *plastron* (Fig.4.2). This hinge can close both the front and rear part of the body, hiding the turtle completely inside. The muscles that hold the shell closed are incredibly tough, and when the hinge is shut, it cannot be opened without harming the turtle. Other type of turtles can also close their shells, although not as completely as the box turtle. Hinge-back tortoises have a hinge across the top of their carapace and can close their back legs, protecting them. Some tortoises have a flexible "hinge" on their plastron which they can use for extra protection from predators by clamping the carapace and plastron firmly shut. Some females of other species have a much less flexible plastron, but nevertheless flexible enough to enable them to move them slightly which aids them in their egg laying duties.

Fig. 4.2: When frightened or harassed, the box turtles retreat into their shells. A hinged lower shell (plastron) enables the turtle to completely close up, protecting its head and legs from predators (Photo by Casey Greider).

4.4.1 Features of Carapace

1. The carapace (Fig. 4.3 a and b) is formed by the fusion of about 50 bones.

2. The carapace of turtles consists of the ossified ribs of turtles which are fused with the dermal bone. The spine and the expanded ribs are fused by ossification to the dermal plates which are present beneath the skin and so form a hard shell. Exterior to the skin, the shell is covered by scutes which are horny plates made of keratin that protect the shell from injury. Scutes have nerve endings, so turtle can feel if something touches its shell. The scutes and the bone underneath can grow allowing the turlte to expand and get larger.

   In some turtles a keel in the form of a ridge runs from the front to the back. The keel may be single or paired or maybe even 3 in number. In most turtles the shell is relatively uniform in structure, varying only in colour and shape. In soft-shelled turtles like pig-nose turtle and leatherback sea turtles the scutes have been lost and ossification of shell has been reduced. Thus the highly aquatic forms are covered only by skin on the dorsal surface.

3. The carapace usually has 38 scutes.

4. Scute patterns – Different species of turtles have scutes of different patterns and designs (Fig. 4.3) and there is often individual differences among members of the same species.

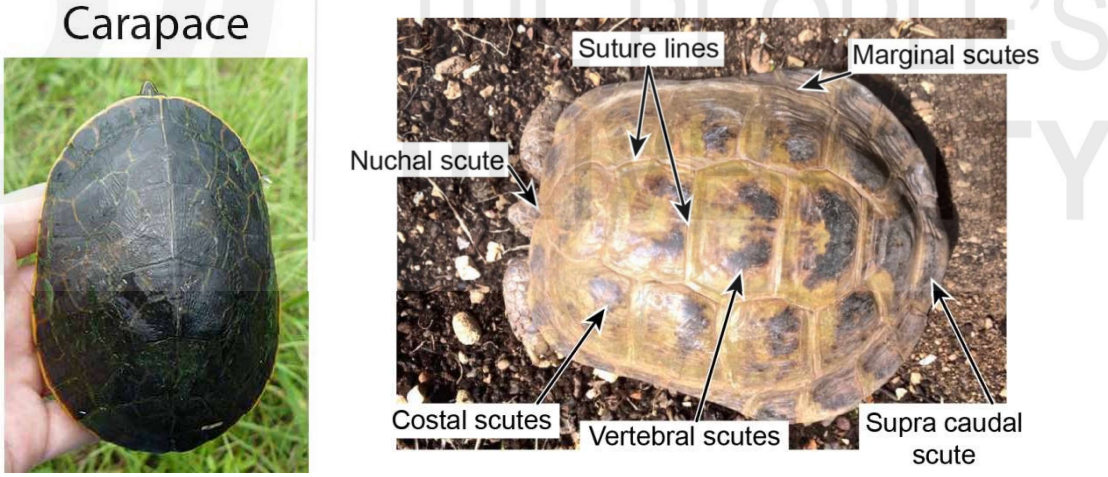


Fig. 4.3: Different shapes an colours seen in carapace.

5. The scutes of the carapace are of five categories (observe Fig. 4.4) according to their placement :

   i) The Nuchal – the scute directly above the head

   ii) The Supracaudal – the scute directly above the tail

   iii) The Vertebrals – a single line of scutes which run centrally from the head to the tail

   iv) The Costals – run parallel to, and at either side of, the Vertebrals

v) The Marginals – flank the Costals and attach to the "bridge". The Marginal scutes have a large influence on the overall shape of a tortoise's shell. In some species, most noticeably *Testudo marginata*, the marginal scutes are extremely flared.

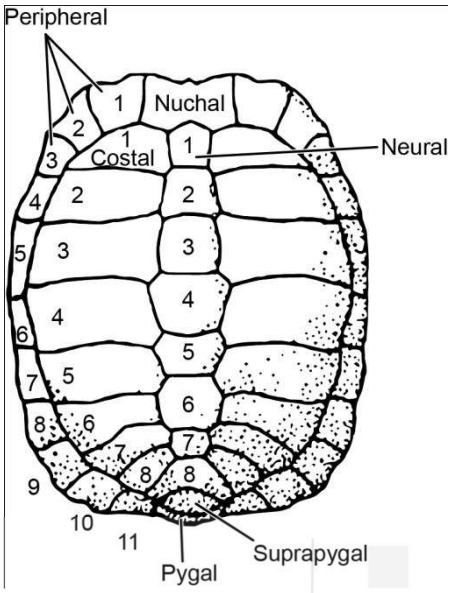


Fig. 4.4: Dermal bones of carapace of tortoise.

4.4.2 Features of Plastron

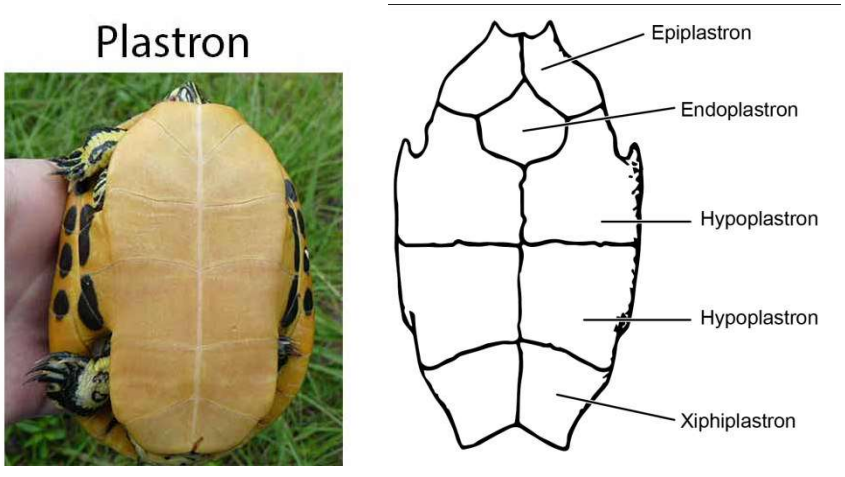
1. Plastron (Fig. 4.5 a & b) is also formed by the fusion of bones which include the clavicle (collar bones), bones between the clavicles, and portion of the ribs. The clavicle (collar bone) becomes a part of the plastron known as the epiplastron. The plastron is formed largely from dermal ossification.

2. The plastron consist of 9 bones (Fig 4.5) which are:

   i) The median endoplastron which lie in front and is derived from the interclavicle,

   ii) The paired epiplastron derived from the clavicles.

   iii) Processess from the hyoplastron fuse with the first and fifth pleurals, forming a rigid connection between the plastron and carapace.



(a) **(b)**

Fig. 4.5: Plastron: a) Photograph; b) line drawing of plastron.

3. The scutes of the plastron (Fig. 4.6 a & b) are also separately categorized. There are two scutes in each category. Starting from the head moving down to the tail we have; Intergular, Gular, Humeral, Pectoral, Abdominal, Femoral and Anal.

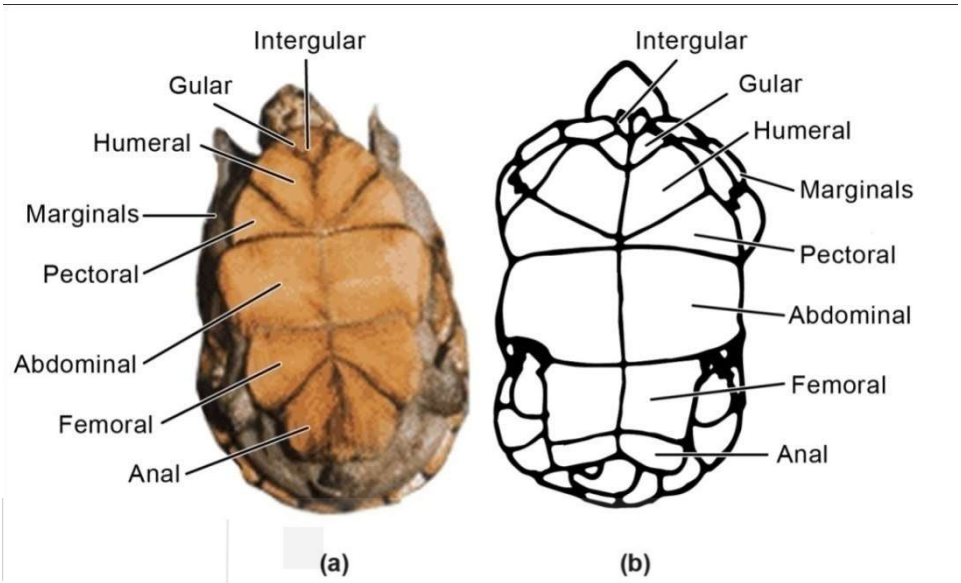


Fig. 4.6: Plastron with scutes a) Photograph; and b) line drawing.

4.4.3 BRIDGE

The bridge (Fig. 4.7) can be seen along the sides and connects the carapace to the plastron.

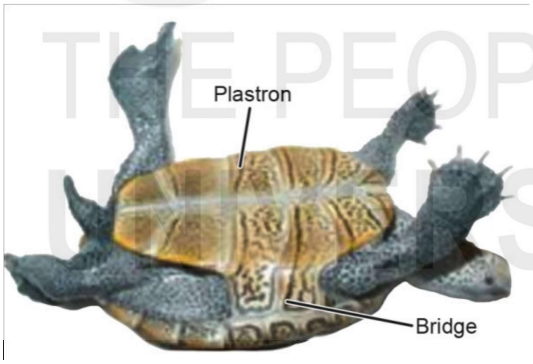


Fig. 4.7: Bridge connecting carapace and Plastron.

4.5 TERMINAL QUESTIONS

1. Differentiate between carapace and plastron.
2. Draw and label carapace and plastron.