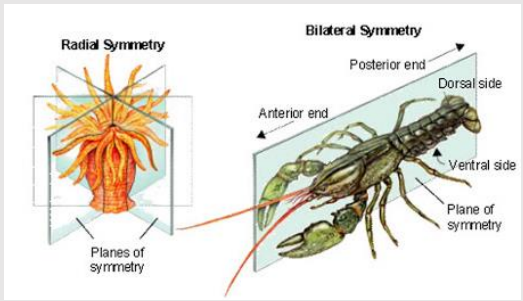
ECHINOIDS

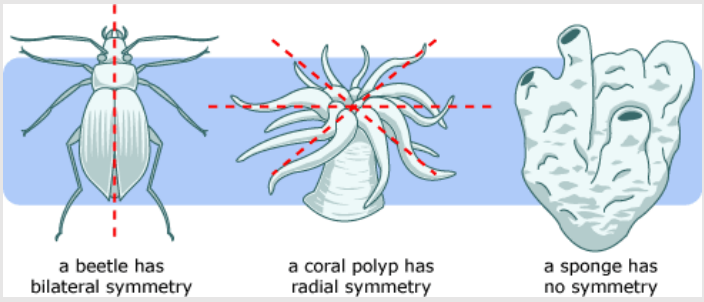
CRINOIDEA

Phylum	Echinodermata
Class	Echinoidea
Genus	Echinoids (or sea urchins)
Extant	Cambrian to recent (did not become common until the Carboniferous and there was rapid radiation during the Mesozoic (early Jurassic))
Types	Regular (five-fold radial symmetry) and irregular (bilateral symmetry)

- **Five-fold symmetry**: means that there are five-fold planes of symmetry on the test. These form a radial pattern.
- **Bilateral symmetry:** means that there is only one plane of symmetry on the test.
- **Test**: the name given to the skeleton of the echinoid, made of small plates of calcite.
- **Tube feet:** are the soft tissue that extend out of the test through pairs of pores.
- **Water vascular system**: is the hydraulic system that fills soft tissue with water to force them outwards and extend them. The amount of water is controlled by the **madreporite**.

The Phylum Echinoidea also includes organisms such as crinoids, sea cucumbers and starfish. Organisms belonging to this phylum generally show five-fold symmetry. They also possess soft tissue called tube feet in life.





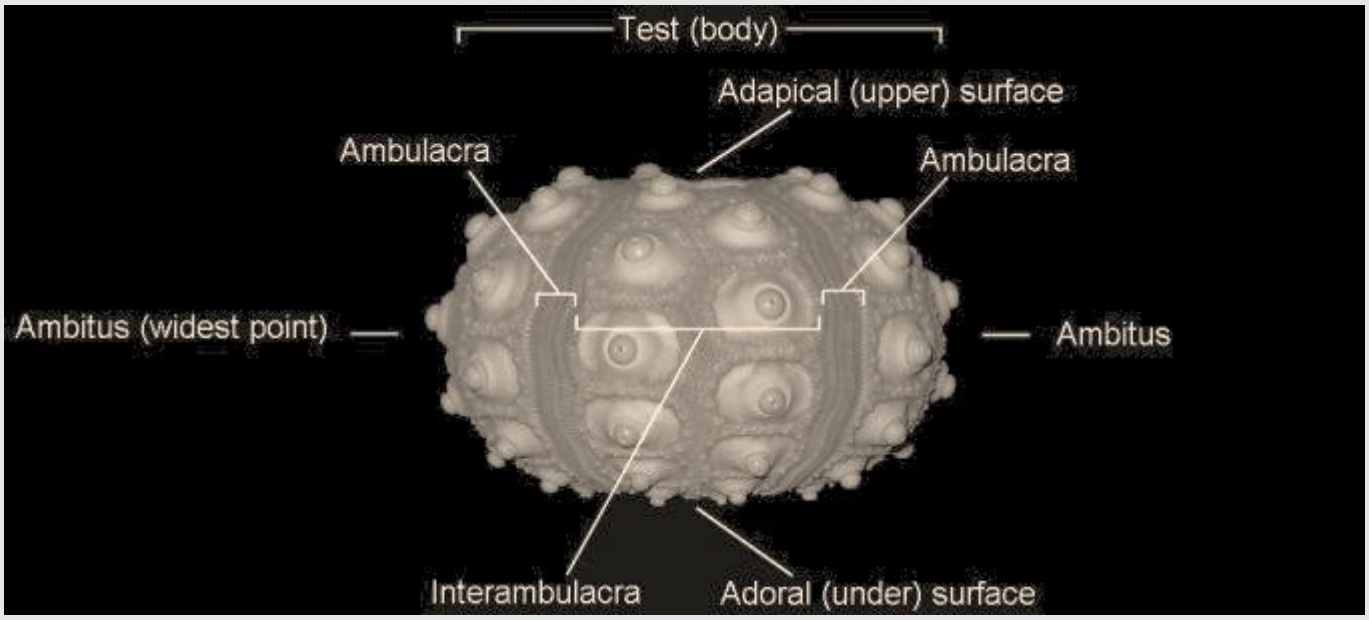
THE MORPHOLOGY OF A REGULAR ECHINOID

The skeleton (test)

The skeleton is called **the test**. It is in the shape of a **hemisphere** and consists of many **interlocking calcite** plates, which define areas called **ambulacra** and **interambulacra**.
There are ten of these areas in total (**five ambulacra** and **five interambulacra**), which **alternately radiate** from the top of the organism.
It is the alternating arrangement of areas of ambulacra and interambulacra that is responsible for giving echinoids their characteristic **five-fold symmetry**.
There is a covering of soft tissue (skin) over the outside of the test.

Ambulacra are narrower and consist of **two rows of plates**, which are **perforated by pore-pairs**. In life, these would have had **tube feet** protruding from each pair.

Interambulacra are wider again and also consist of **two rows** of plates. They may have **tubercles** on their surface which have **spines attached** in life.



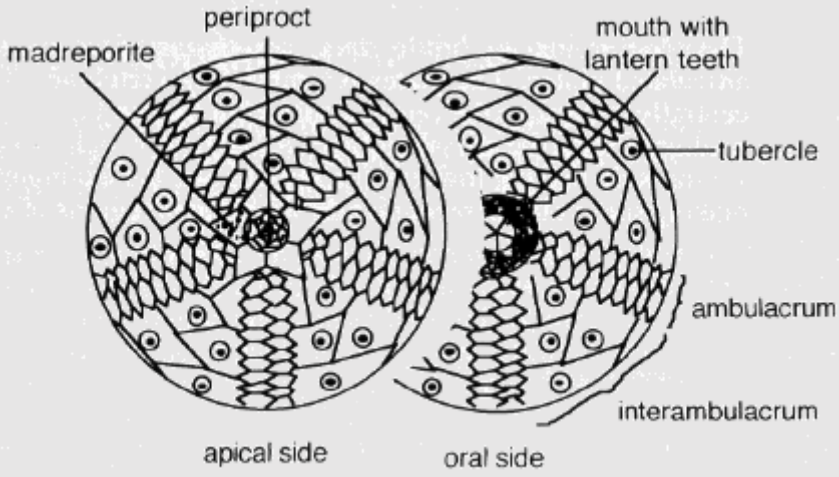
The apical system

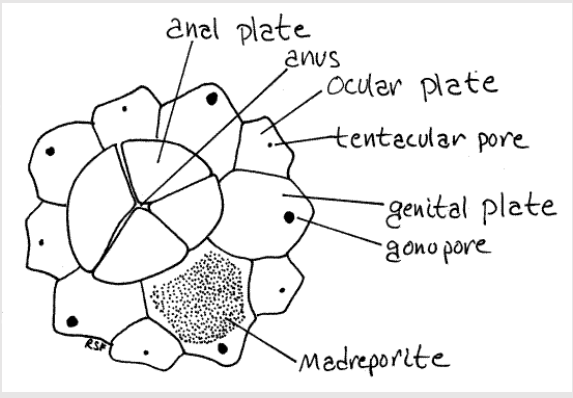
This consists of **ten plates** arranged in **two rings around a central anus**. This is on **the aboral (upper**) surface of the echinoid as the anus and the apical system requires the removal of waste, eggs and sperm to be easy – **water currents** play an important role here.

Of the ten plates; there are **five genital plates**, the **largest** of which is the **madreporite**, which is perforated by many **tiny pores** to allow **water to enter** the organism's **water vascular system**.

In-between these large plates are **five smaller ocular plates**.

The anus itself is surrounded by a **membrane** called the **periproct.**





The mouth

The mouth is in the **centre of the lower or oral** surface and is surrounded by **a membrane** called the **peristome**.

The edges of the test are turned inwards to form a lip named the **perignathic girdle**. This allows the feeding apparatus to be **attached and supported** inside the test. There are **five jaws**, each with a **single sharp tooth** supported inside the mouth, called **Aristotle's lantern.**

These teeth can **scrape algae** or other food from the substrate and pass it inside the animal towards the gut. The mouth is on the **oral (under) surface** of the echinoid so feeding on the substrate is easy.

Tube feet

Tube feet are the **soft tissue** parts that **extend out** of the pairs of pores on the **ambulacral plates** of the test. They have three main functions:

1. **Attachment to the substrate**
2. **For locomotion/movement**
3. **An exchange surface for respiration**

The tube feet are part of the **water vascular system**. Water enters the animal through the **madreporite** (on the aboral side as part of the **apical system**) and eventually reaches the tube feet.
The **exchange of oxygen and carbon dioxide** takes place directly through the **membranes** of the tube feet.
Tube feet are also used for **attachment to rocks**, acting as **suckers** to secure them in place and helping the animal to move around on the seafloor.

Spine attachment

Spines are attached to the test where the **tubercles protrude** on the **interambulacral plates**.

Tubercles consist of two parts; **the boss, a wide base**; and the **mamelon,** a **nipple-like structure** in the **centre** of a boss.

Muscle attaches the spines to the base of each tubercle and as a muscle, they can **contract to twist**/move the spine in a **coordinated manner**. This allows the echinoid to rotate the spines and **use them for** w**alking**. The spines also prove useful as **defence against predators**. Spines are not preserved with the echinoid test since after death, the **muscles decay** as they are made of soft tissue and the spines **become disarticulated.**

THE MODE OF LIFE OF A REGULAR ECHINOID

They live on rocky shores in the littoral zone. This is a high energy environment but they are well-adapted with a robust, thick calcite test and numerous stiff spines. They can attach/suck onto substrates like rocks for protection against high energy currents.

They move along the shore in any direction, clinging to rocks using their tube feet and spines and rotate their spines to allow for walking along a surface. The tubercle size reflects the size of the spines that may be attached.

They feed by grazing for algae on rocks or by scavenging for other/dead food particles. The feeding apparatus is attached via the perignathic girdle with five jaws and a sharp tooth on each. These teeth/jaws will scrape off the food and pass it to the gut.

Spines help protect against predation and large echinoids also need larger tubercles and so spines to support their larger mass.