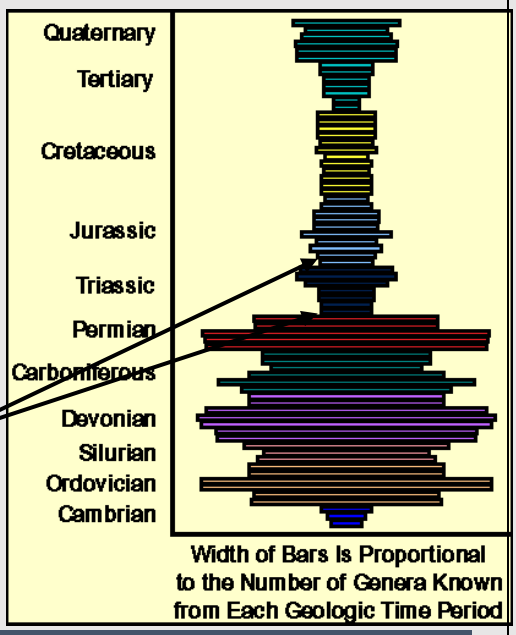
BRACHIOPODS

WHAT ARE BRACHIOPODS?

- Brachiopods are **sessile,** marine organisms that live in a b**enthonic** environment enclosed between two **unequal sized valves**.
- They may be attached to the **substrate or free lying** (**epifaunal**) or more rarely, **burrowers (infaunal**).
- They are **filter feeders.**
- They show **bilateral symmetry** (one plane of symmetry with two identical halves).
- Evolved in the **Cambrian** and became widespread and dominant in the **Palaeozoic era**.
- Brachiopods are **extant** but in greatly reduced numbers. They were almost wiped-out at the **Permian-Triassic extinction** and there were also major losses at the **Triassic-Jurassic** boundary.



CLASSIFICATION AND STRUCTURE

They belong to the Pylum **Brachiopoda (a minor phylum today).**

There are two major classes:

1. **The inarticulates** (specific species are not required in the OCR course)
   They have no hinge between their brachial and pedical valve. They are smooth and small with an oval or circular outline. These brachiopods do not possess teeth and sockets and do not have diductor muscles.
   They instead have a complex internal **musculature (***the system or arrangement of muscles in a body*). As such, they are unable to open or close their valves. This does, however, prevent shearing and wearing.
   Most inarticulates construct their exoskeletons from chitin and calcium phosphate rather than calcium carbonate. Inarticulates have never existed in large numbers and have not evolved much since the Cambrian. This makes them geologically unimportant as a species.
   On the right is pictured an inarticulate burrower called Lingula.

   Lingula has changed little since the Cambrian. Modern Lingula live successfully in shallow, brackish intertidal conditions. The pedicle extends deep into a burrow and when disturbed, the pedicle contracts so that the brachiopod **sinks into the burrow for protection**.

2. **The articulates**
   These are the **most common** type of brachiopod, numerous in the fossil record and an important part of many **fossil assemblages** from all different environments.
   They do have a hinge lien between their valves, which Is held together by teeth and socket joint and also by **antagonistic muscle pairing** *(muscles that have opposing action on each other).*

They have shells constructed of **calcium carbonate** and have a **mineralised lophophore support structure** inside their shells.

Key terms

Lophophore support structure: A feeding mechanism containing a pair of grooved lobes or arms (brachia) with a fringe of ciliated tentacles.

A lophophore is a fluid-filled set of filaments lined with cilia**.** The cilia generate currents that enable food particles to be trapped. This is a **food-gathering** and **respiratory system**.

Brachial valve: Usually the smallest valve (**upper in life position = dorsal**)

Pedicle valve: Usually the larger valve (**lower in life position = ventral**)

Muscle scar: An aberration on the inside of the cell where the muscle was attached.

A pedicle: A fleshy stalk of muscle, used to attach the brachiopod to the sea floor.

Cilia: The numerous projections from the surface of some cells that have the ability to waft to move substances or generate currents.

Diductor muscles: the muscles that contract to open the valve. There are two pairs that run from the central floor of the pedicle valve to the cardinal process in the brachial valve. (the cardinal process is the site where the diductor muscle attaches). They pull on the dorsal/brachial hinge area to open.

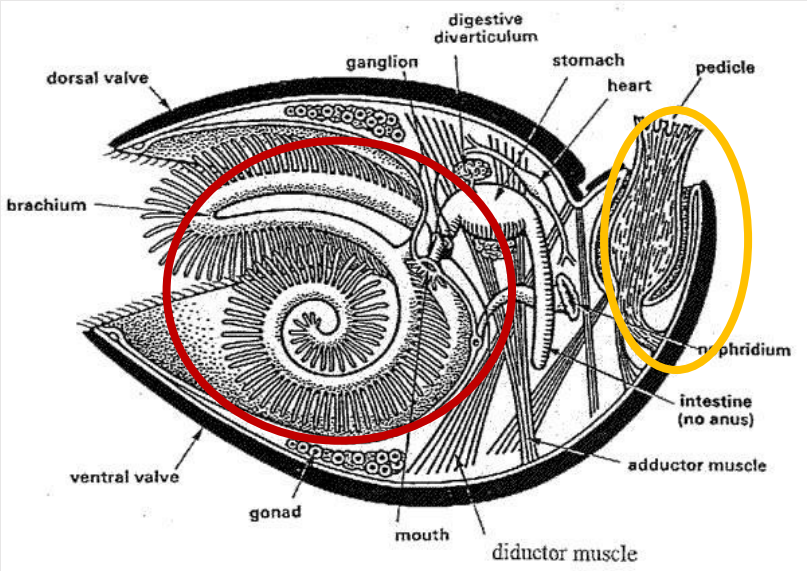
Adductor muscle: contracts to close valves. They leave a pair of muscle scars in the pedicle valve and two pairs in the brachial valve.

Commisure: The boundary/line where the brachial and pedical valves meet.

The pedicle varies from being a **thick muscular stalk** to a **thin series of threads** depending on the environment and species of brachiopod.

The pedicle valve has a **pedicle foramen** through which a **fleshy stalk, the pedicle**, protrudes. The pedicle attaches the brachiopod to the sea floor. It is made of muscle and has the ability to l**ine the brachiopod to the curren**t. Some brachiopods would not possess a pedicle and instead **lie freely** on the sediment.

Inside the shell are a **mantle cavity and the lophophore**. The **brachial valve** contains the **support for the lophophore**. It is the lophophore that draws seawater into the shell (by generating currents) and removes suspended food with **sticky tentacles.** When the brachiopod feeds, water is drawn in and out through **separate chambers created by the lophophore**. Currents are generated by cilia that drive water between tentacles.



Red = lophophore

Yellow = Pedicle

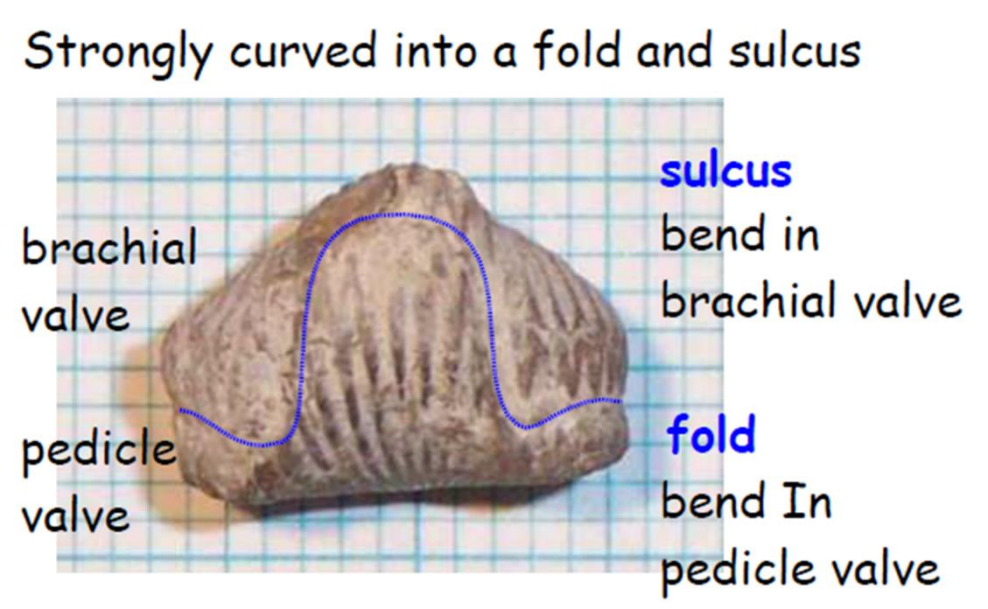
- The pedicle is located in the **posterior region**. The hole for the pedicle is the **pedical foramen** which is sometimes closed by a plate (deltidium) or by two plates (**deltidial plates**).
- Patterns of **muscle scars** preserved on the interior of shells are species specific.
- Brachiopod shells grow by accretion (gradual build-up of layers). The **Umbo** (also called the beak) marks the point of first growth.
- The **fold and sulcus** is an evolutionary adaption seen in Brachiopods which acts to **separate incoming and outgoing water currents.** The fold and sulcus is a **depression in the centre of the valves**. NOT all Brachiopods have this structure. It is important for **filter feeders** to have distinct incoming/outgoing currents to **increase the efficiency of filter feeding** and for **hygiene.**

  Brachiopods commonly have **an exterior surface texture**. This may be in the **form of ribs** radiating from **the umbo**, growth lines or wrinkles.

  The line of closure (the Commisure) may be straight or corrugated. It may also have a deep medial

depression (**a sulcus)** and a corresponding elevation (**fold**). The **hinge line** may be **strophic** (straight) or **astrophic** (curved).

- In epifaunal brachiopods. The main functions of the shell are to **guide food-bearing water** into the mantle cavity, **limit the contamination** of nutrient-rich currents with waste-bearing currents, and **prevent sediment entering the shell.**



HOW DID BRACHIOPODS LIVE?

Studies of modern-day brachiopods show us the soft tissues and other internal structures of the animal. This is then compared to structures in the fossil record so we can infer t**he mode of life**.

The shell is **secreted by the soft tissue** of the **mantle of the shell**. This is similar to bivalves, but this similarity has arisen by **independent paths of evolution**, as the bivalves and brachiopods evolved from completely **different soft-bodied ancestors**.

All members of this phylum are **filter feeders**, with **the lophophore** taking up at least 2/3 of the space inside the shell, and with the body occupying the remaining 1/3 . The lophophore is fluid filled and covered on the outside by a **large number of cilia**. The beating of cilia generates currents to bring in food-bearing water and remove waste-bearing water. The **tentacles are sticky** and act as a net for catching small organic particles (in **particular phytoplankton**).
It is most important that **free-lying brachiopods separate** water intake and outtake waters since they are closer to the **sediment on the seafloor**.

To be able to feed, a brachiopod must be able to **open** its valves to allow fresh water to enter the valve. This is achieved by **contracting the diductor muscles**. These are attached to the **cardinal process** of the **brachial valve** and the **central part of the pedicle valve**. the valves open, articulating on **teeth and sockets.**

It is the adductor muscles that leave a muscular scar. They attach to both the central parts of the brachial valve and the pedicle valve.
Muscle cars are only occasionally found in the fossil record since brachiopods usually have their **shells joined together (articulated).**