

**VISCERAL ARCHES**—Together, these structures form the **splanchnocranium**. They are skeletal elements that support the **pharynx**, the anterior part of the gut tube corresponding to the **throat**. Each arch consists of two major skeletal elements (plus smaller ones) connected by joints, forming a series of U-shaped structures surrounding the pharynx. In ancestral vertebrates, the visceral arches supported the pharynx so that water could flow into the mouth and out the slits between the arches where food particles were trapped (**filter-feeding**). Ancestrally there were many arches, but some of the anterior-most and posterior-most arches were lost, eventually leaving only **7 visceral arches in the ancestral vertebrate**. The **1<sup>st</sup> (anterior) arch** eventually was modified to form the **upper and lower jaws** and is called the **mandibular arch**; the **2<sup>nd</sup> arch** was modified to suspend and support the jaws and is called the **hyoid arch**; the remaining arches supported the pharynx, just as they did ancestrally, but eventually gills formed in this location and **arches 3-7** are now called the **branchial (or gill) arches**. In tetrapods, most of the posterior branchial arches are lost, but some, together with the **ceratohyal** of the hyoid arch, form the **hyobranchial apparatus**, which supports the throat and tongue. Some of the cartilages of the larynx and trachea are also remnants of the gill arches. The cartilages and bones of the visceral arches develop from neural crest cells.

**BRANCHIAL ARCH**—Visceral arches 3-5 are the branchial arches. In fishes, these support the gills and are therefore gill arches. In tetrapods, the first two or three contribute parts to the hyobranchial apparatus, laryngeal cartilages and anterior tracheal cartilages, but most of the branchial arch elements are lost.

**PHARYNGEAL POUCHES**—Within the space or volume of the **pharynx** (the anterior part of the **gut tube** just behind the mouth or buccal cavity), there are lateral out-pockets between each of the visceral arches. In fishes (including ancestral vertebrates), these open to the outside through **pharyngeal/gill slits**. In tetrapods the pouches do not open to the outside, but they give rise to other structures. The **1<sup>st</sup> pharyngeal pouch** forms the **spiracle** of fishes and the **middle ear cavity** of tetrapods.

**NEUROGENIC EPIDERMAL PLACODES**—Formed within the **epidermis** (outer, **ectodermal** layer of the skin) in early embryos. Patches of the epidermis lateral to the neural plate thicken to form various parts of the special sensory organs. An anterior pair sink in and are surrounded by the nasal capsules of the chondrocranium where they form the **sensory cells of the nose**; a second pair sink in to form the **lens** of the developing eyeball within the optic capsule; a third pair sink in and are surrounded by the developing otic capsules of the chondrocranium, forming the **sensory parts of the inner ear**.

**SENSORY CAPSULES**—The cartilaginous cups or capsules that fuse to the developing **neurocranium** to form the complete **chondrocranium**. Three pairs of capsules form on each side corresponding to the **olfactory (nasal) capsules**, **optic capsules** and **otic capsules** (from front to back). They contain the special sensory organs of the head (**nose**, **eyes** and **inner ears**) and ossify endochondrally in bony vertebrates. The sensory structures (or lens, in the case of the eye) are derived from the **neurogenic placodes**, which sink into the developing sensory capsules.

**NEUROCRANIUM**—The embryonic cartilaginous structure that ‘cups’ the brain. In fishes it forms a complete set of walls around the brain—this condition is retained in adult cartilaginous fishes (with the addition of a cartilaginous roof). In tetrapods, the neurocranium is reduced so that the anterior part of the brain is not covered with cartilage. The neurocranium plus the **sensory capsules** forms the **chondrocranium** of the embryonic skull, which ossifies in adult bony vertebrates.

**CHONDROCRANIUM**—The fusion of the **neurocranium** and the **sensory capsules** in the embryonic head skeleton containing the brain and special sensory organs, respectively.

**SPLANCHNOCRANIUM**—The part of the **head skeleton** contributed by the visceral arches. Derived from **neural crest** cells.

**DERMATOCRANIUM**—The part of the **head skeleton** contributed by **dermal (membrane) bone**. In adult bony vertebrates, most of the visible skull is dermatocranium because the parts of the chondrocranium and splanchnocranium that remain in the adult are either covered over by dermal bone or fuse with dermal bone. Dermal bones of the head skeleton are derived from **neural crest** cells.