Hello students, I am Karishma Kushta Naik from Government College of Arts, Science and Commerce Quepem. The title of the unit is Unit-4 Respiratory system and the name of my module is Accessory respiratory organs.

The outline of this module is Introduction, Origin of accessory respiratory organs, List of accessory respiratory organs and functions of accessory respiratory organs. At the end of this module, students will be able to list the accessory respiratory organs, describe accessory respiratory organs and to explain the functions of accessory respiratory organs.

Now, let's start with the module,
Introduction- In aquatic vertebrates, gills are the chief respiratory organs.
The land vertebrates have the lungs for respiration, additional structures other than gills and lungs, which help in respiration, are known as accessory respiratory organs. Now let's see the origin of accessory respiratory organs. The development of accessory respiratory organs in fishes and some amphibians took place in order to cope with danger of drying streams, reduction of large reservoirs and consequent scarcity of oxygen in aquatic habitat.
Now, in this slide you can see the list of accessory respiratory organs.
1) Skin
2) Labyrinthine organ
3) Epithelial lining
4) Cloacal bladders
5) Pharyngeal diverticula
6) Branchial diverticula
7) Swim or Air bladders
Now we are going to discuss this in detail, so let's take the first one.
1) Skin: Some fishes like common eel, Anguilla can travel by wriggling on damp grass though it has no special respiratory organs, but it has vascular areas in the skin by which it can breathe both in water and on land. In this picture you can see the Anguilla.
In amphibians, the moist skin is highly vascular. Lungless salamanders (Plethodont's) respire only through skin. African male hairy frog *Astylosternus* have vascular hairy cutaneous outgrowths which act as respiratory surface.
In this picture you can see *Astylosternus* which is an African male hairy frog.
In the mud-skipper *Periophthalmus* the caudal fin is highly vascular, the head and trunk of the fish project above the water when it perches on a rock, only the caudal fin remains submerged and acts as a respiratory organ. In this picture you can see a mud-skipper which is perching on a rock.

2) Labyrinthine organ: Here 2 examples are there. Let's take first one
i) The Indian climbing perch *Anabas scandens* has special air chambers above the gills, where three concentrically folded bony laminae, called Labyrinthiform organs are developed from the first epibranchial bone on each side. Now in this picture you can see the anabas and its labyrinthine organ which is present somewhere here.
ii) Ophiocephalus: there is an accessory branchial cavity on each side above the gills.

3) Epithelial lining: In some fishes and aquatic amphibians, the lining of cloaca, rectum, gut or bucco-pharyngeal epithelium is highly vascular and aids in respiration. In *Calichthys*, rectal respiration takes place, the rectum is highly vascular into which water is alternately taken in and pumped out.

The loach, *Misgurnus* swallows air which passes through the intestine and is voided by the anus, the highly vascular mucous membrane absorbs oxygen from the air, carbon dioxide is also passed through the anus.

4) Cloacal bladders: In some aquatic turtles, pair of thin-walled, lateral and greatly vascular cloacal bladders is continually being filled and emptied of water through vent and serve as important respiratory organ.

5) Pharyngeal diverticula: The Indian 'Cuchia eel' *Amphipnous* has poorly developed gills, but on each side of the body there is a vascular sac as an outgrowth of the pharynx which opens anteriorly into the first gill-cleft and these sacs are respiratory. Now in this picture you can see the air sac and the pharyngeal diverticula.

6) Branchial diverticula: In the Indian catfish, *Saccobranchus* there is a pair of large air sacs, each arising from the branchial chamber and extending laterally backwards into the trunk muscles.
They can be filled with air for respiration.
Now in this picture you can see in the *Saccobranchus* and the branchial diverticula of that *Saccobranchus*.
The catfish, *Clarias* has a pair of Supra-branchial organs, each lying on one side and divided into two parts, a highly branched arborescent organ formed from 2nd and 4th branchial arches and a vascular sac of the branchial chamber which encloses the arborescent organ.
Now here in this picture you can see the arborescent organ of the Clarias.

7) Swim or air bladders. The swim or air-bladder is arises as a diverticulum from the pharynx, or oesophagus in bony fishes. It is originally lateral in position but becomes dorsal. It usually lies below or lateral to the vertebral column outside the coelom.
Now in this picture you can see the structure of swim bladder. Now there are two types of these swim bladders physostomous swim bladder which is directly connected to the gastrointestinal tract, and the physoclistous swim bladder which is not connected to the digestive tract.

Let's move towards the functions of accessory respiratory organs
The fishes possessing accessory respiratory organs are capable of living in water where oxygen concentration is very low, since these organs contain a high percentage of oxygen. The acquisition of accessory respiratory organs in fishes is an adaptive feature.
Fishes come to the surface of water to gulp in air for transmission to the accessory respiratory organs. If these fishes are prevented from coming to the surface, they will die due to asphyxiation.
The rate of absorption of oxygen in such organs is much higher than the rate of elimination of carbon dioxide.
Hence, it is natural that the gills excrete most of the carbon dioxide.
Absorption of oxygen appears to be the primary function of the accessory respiratory organs.
Now, in this slide you can see the references for this module. Thank you.