Storming the Beaches - Vertebrates Transition from Water to Land

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During the Devonian Period, about 375 million years ago, a group of vertebrates clamoured their way out of the water and onto land. This event, this crossing of the boundary between sea and solid ground, meant that vertebrates had at last concocted solutions, however primative, to the four basic problems of living on land. In order for an aquatic vertebrate to successfully colonize land, that animal:

- **must withstand the effects of gravity**
- **must be able to breath air**
- **must minimize water loss (dessication)**
- **must adjust senses so they are suited for air instead of water**

The effects of gravity create significant demands on the skeletal structure of a land vertebrate. The backbone must be able to support the animal's internal organs and to effectively distribute weight downward into the limbs, which in turn transmit the weight of the animal to the ground. The skeletal modifications to accomplish this included an increase in the strength of each vertebra to hold the added weight, the addition of ribs which further distributes weight and adds structural support, and the interolocking of vertebrae so the spine maintains the necessary posture and spring. Additionally, the pectoral girdle and the skull, which are attached in fish, are separate in land vertebrates to enable the shock incurred during movement to be absorbed.

Early land vertebrates are believed to have arisen from a line of fishes that possessed lungs so the ability to breathe air was possibly quite developed at the time land

Ref: Tudge C. 2000. The Variety of Life. Oxford: Oxford University Press.
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vertebrates were first making their foray onto dry soil. The bigger problem to tackle was how the animal disposes of excess carbon dioxide, and this challenge, to a possibly larger extent than acquiring oxygen, shaped the breathing systems of early land vertebrates.

Dealing with water loss (also referred to as dessication) presented early land vertebrates with challenges as well. The loss of water through the skin can be minimized in a number of ways: by developing watertight skin, by secreting a waxy waterproof substance through glands in the skin, or by inhabiting moist terrestrial habitats.

The last main challenge to life on land is the adjustment of sensory organs to function on land instead of in water. Modifications in the anatomy of the eye and ear were necessary to compensate for the differences in light and sound transmission through air instead of water. Additionally, some senses were lost such as the lateral-line system which in water enables animals to sense vibration in the water and which in air holds little value.

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