

i21 The amniote egg < allantois, our ancestor >

During evolution, it is the change in genes that leads to the creation of new patterns of development. ... It is advantageous for the unit of reproduction (the propagule) to be as small as possible (that is, a single cell), as the uniformity thus created will reduce the likelihood of conflict between cells. ... In a [multicellular] organism that [hydra-like] only reproduces by asexual budding, it is impossible to evolve significant changes. There is no way that the genes in the huge number of cells involved in budding can change at the same time, and mutations in individual cells mean that they no longer share the behavioural rules of the majority. It is only through a coherent developmental programme, with all cells possessing the same genes, that organisms can evolve, and this requires an egg.

—Lewis Wolpert & Eörs Szathmáry, 2002.³

Mammals, which evolved from reptiles, have mammae that in the case of the female can yield milk for nurturing the young. Birds, which also evolved from reptiles, either do care for the young—perching birds presently cater to nestlings: the bird of prey, by bringing back morsels, the song bird, by regurgitate food into gaping beaks, or don't—ground bird hatchlings must feed themselves, however, while young, they follow the mother who guides them to where food is available and provides some protection by fending off predators as far as she is able. Extant reptiles do not feed their young. When their hatchlings emerge from their egg they must be immediately be capable of finding and eating the same food as the adult. Some reptile mothers, as is so for crocodiles, will carry the newly emerged hatchlings in their open mouth from the sand bank where their eggs were laid and buried to a place where they can find some concealment as among reeds. Evidently some dinosaurs did feed nestlings. The reptilian/bird egg has evolved a large store of food (yoke) so that for those that must feed themselves the embryo can develop to the stage of being a miniature adult before it hatches. Eggs laid out of water on the land must be protected against desiccation. The solution is a waterproof shell. But to succeed this requires a preadaptation (namely the allantois, see below) in the ancestral water-laid egg to finesse metabolic waste such as urine that if prevented from escaping must accumulate in the incubating egg and poison the growing embryo. The evolution of the amniote egg realized a full solution.⁴

An amniote egg (**Figure *i21.1***) has a waterproof but gas permeable leathery or hard-calcareous shell that encloses a gas pocket (for expansion or contraction of its content as ambient temperature varies), cushioning albumen (egg white) that encloses a chorion, a membrane that encloses an amnion membrane that holds a “miniature ocean” in which the aquatic embryo lives, and two sac membranes, the yoke sac and the allantois, that extend from within the embryo to its outside. The allantois is both a receptacle for cloacal wastes and, with blood vessels that exchange gases and a large surface near the chorion, it functions as a “lung” for the embryo. The allantois allows the egg to be as big as is necessary to house sufficient yoke for the embryo to become a miniature adult before it hatches.

In placental mammals, the fetus' amnion fuses with the walls of the mother's uterus, and it and the chorion become the placenta, when the enclosed tiny yoke sac and the allantois become the umbilical chord. It is the fluid-filled chorion that “breaks” at the onset of labor.

Mammals, reptiles, and birds regardless that some live exclusively on the land (as ourselves, lizards and extinct dinosaurs), can fly (as bats, birds and extinct pterosaurs), are amphibious (as crocodilians and turtles) or live exclusively in water (as whales and extinct ichthyosaurs) have all evolved from a putative terrestrial reptilian ancestor that defines the clade amniota. □

(**Figure *i21.1* cont.**) “it rotates and is swathed in egg-white, which, twists at the long ends like a candy wrapper” and “the white's end-knots are easily found when an egg is cracked open.” The white is added during the hour the egg takes to pass down the isthmus of the oviduct. Two membranes bound it, and these “are in contact with each other over the whole surface of the egg white, except at the egg's blunt end, where they part company to form the air sac [air space]. In the uterus or shell gland the egg waits eighteen to twenty hours as calcium salts from the tissue of this cavity create the shell, and the hen's body gently kneads the egg into its oval (literally, ‘eggy’) shape.” What then “prompts the hen to lay her egg is not completely understood. The act takes only a few seconds and it is often greeted by the hen with a cackle of triumph.”