The difference between fish and humans: Scientists answer century-old developmental question

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Embryologists at UCL (University College London) have helped solve an evolutionary riddle that has been puzzling scientists for over a century. They have identified a key mechanism in the initial stages of an embryo's development that helps differentiate more highly evolved species, including humans, from less evolved species, such as fish. The findings of the research were published online today by the journal *Nature*.

Early on in development, the mass of undifferentiated cells that make up the embryo must take the first steps in deciding how to arrange themselves into component parts to eventually go on to form a fully developed body. This is a process known as 'gastrulation'.

During this stage, the cells group into three layers, the first is the 'ectoderm' which then in turn generates the 'mesoderm' and 'endoderm' layers. In higher vertebrates, such as mammals and birds, the mesoderm and endoderm are generated from an axis running through the centre of the embryo. However, in lower vertebrates, such as amphibians and fish, the two layers are generated around the edge of the embryo.

Using chicken eggs and a state-of-the-art imaging device which can reveal how cells move in three dimensions, the researchers demonstrated a key difference in the way gastrulation occurs between higher vertebrate species and less evolutionarily advanced animals. They

discovered that the reason why higher vertebrates form their axis at the midline of the embryo is because during evolution they acquired a new mechanism of “cell intercalation” which positions the axis at the midline. They also discovered the molecules used by the embryo to control these cell movements.

Scientists have been speculating for over a century on the difference between the embryonic development of higher vertebrates and lower vertebrates, to help answer how the simple cell structure of an embryo goes on to form the various highly complex bodies of different species. Research leader Prof Claudio Stern explains: “This is a significant find as it is a clear difference between the embryonic development of more advanced species and less advanced species. It suggests that higher vertebrates must have developed this mechanism later on in the history of animal evolution.

In humans this process occurs during week 3 of embryonic development, and forms the cut-off point for scientific research on human embryos in the UK.

Source: Biotechnology and Biological Sciences Research Council