

"Developmental Capacity of Nuclei Transplanted from Keratinized Skin Cells of Adult Frogs" (1975), by John Gurdon, Ronald Laskey, and O. Raymond Reeves ^[1]

By: Cohmer, Sean Keywords: [Frogs](#) ^[2] [Nuclear transplantation](#) ^[3]

In 1975 [John Gurdon](#) ^[4], [Ronald Laskey](#) ^[5], and [O. Raymond Reeves](#) ^[6] published "Developmental Capacity of Nuclei Transplanted from Keratinized Skin Cells of Adult Frogs," in the *Journal of Embryology and Experimental Morphology*. Their article was the capstone of a series of experiments performed by Gurdon during his time at Oxford and Cambridge, using the [frog](#) ^[7] species [Xenopus laevis](#) ^[8]. Gurdon's first experiment in 1958 showed that the nuclei of *Xenopus* cells maintained their ability to direct normal development when transplanted. The goal of Gurdon's experiments was to show that specialized adult cells could maintain the information and capacity to direct normal development. He asked whether cells undergo permanent changes once they become fully specialized. Gurdon, Laskey, and Reeves's publication was important to [embryology](#) ^[9] because it shed light on that very question.

In their experiment Gurdon, Laskey, and Reeves used the methods of [nuclear transplantation](#) ^[10], originally developed by Robert Briggs and Thomas King, to move a frog's skin cell [nucleus](#) ^[11] into an inactivated [egg](#) ^[12] cell. First, the [nucleus](#) ^[11] of a *Xenopus* [egg](#) ^[12] cell was inactivated with ultraviolet (UV) exposure. Next, a *Xenopus* skin cell [nucleus](#) ^[11] was removed with a forged glass pipette and then placed into the inactivated [egg](#) ^[12] cell. After transplantation the cells were cultured for three and a half days where they proceeded to cleave and undergo development. The cultured media was extracted and the protein contents were destroyed which left behind pure chromosomal material. Next, a second [egg](#) ^[12] cell was inactivated using the same UV [radiation](#) ^[13] method and the [nucleus](#) ^[11] from a cultured cell was transplanted into the second recipient [egg](#) ^[12] cell—a process referred to as [serial nuclear transplantation](#) ^[14].

It was crucial that the researchers differentiated between the recipient cell type and the cell type of a [frog](#) ^[7] cloned from transferred skin cells. To do this, they selected a marker that was present in all [frog](#) ^[7] cell nuclei, the nucleolus. A normal *Xenopus* [frog](#) ^[7] develops with two nucleoli in each cell, while the frogs used as donors contained only one nucleolus in each cell. Due to that fact, single nucleolus markers in each of the tadpoles that developed from [serial nuclear transplantation](#) ^[14] could be detected. Gurdon noted that the odds were astronomically high that the developed tadpoles might contain the one-nucleolus marker through development with the original recipient [nucleus](#) ^[11].

Several conclusions followed from the experiments. First, specialized cells have the capacity to direct normal development under the right conditions. Therefore, the [nucleus](#) ^[11] must contain some inherited material, which holds onto and passes information along. Second, [egg](#) ^[12] cell cytoplasm has properties that allow it to organize and regulate normal development even with nuclei transferred from differentiated cells. Without the [egg](#) ^[12], no development occurs. Perhaps the most important conclusion of the article was, "...cell specialization does not involve any loss, irreversible inactivation or permanent change in chromosomal [genes](#) ^[15] required for development."

Though Briggs and King influenced Gurdon's work heavily, he, with the help of Laskey and Reeves was able to show that some material within the [nucleus](#) ^[11] could direct normal development. Their 1975 article helped to solidify the knowledge regarding the functional role of the [nucleus](#) ^[11] as being necessary but insufficient for normal development.

Sources

1. Gilbert, Scott F. [Developmental Biology](#) ^[16] 8th ed. Sunderland, Ma: Sinauer, 2006.
2. Gurdon, John B., Tom R. Elsdale, and Michael Fischberg. "Sexually Mature Individuals of *Xenopus-Laevis* from the Transplantation of Single Somatic Nuclei." *Nature* 182 (1958): 64–5.
3. Gurdon, John B., Ronald A. Laskey, and [O. Raymond Reeves](#) ^[6]. "[Developmental Capacity of Nuclei Transplanted from Keratinized Skin Cells of Adult Frogs](#) ^[17]." *Journal of Embryology and Experimental Morphology* 34 (1975): 93–112.
4. King, Thomas J., and Robert Briggs. "The Transplantation of Living Nuclei from Late Gastrulae into Enucleated Eggs (R-Piapiens)." *Anatomical Record* 117 (1953): 556.

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