The widest gap, still to be filled, between two fields of research in biology, is probably the one between genetics and embryology. It is the repeatedly stated--and thus far unsolved problem--of understanding how cells with identical genomes may become differentiated, that of acquiring the property of manufacturing molecules with new or, at least, different specific patterns or configurations.  

Jacques Monod, 1947
The developmental capacity of nuclei transplanted from keratinized skin cells of adult frogs.
By J.B. Gurdon, R.A. Laskey, and O.R. Reeves

Goal:
• To determine whether nuclei undergo irreversible changes during cellular differentiation.

Technique:
• Use adult, differentiated nucleus to generate frog
Extract and lyse donor cell

Micropipette

Donor nucleus inserted into enucleated cell

Membrane heals

Somatic cell nucleus in an activated egg

Wild-type donor of enucleated eggs

Albino parents of nucleus donor
These really have developed all types of specialized tissues

The developmental capacity of nuclei transplanted from keratinized skin cells of adult frogs. By J.B. Gurdon, R.A. Laskey, and O.R. Reeves

Goal:
• To determine whether nuclei undergo irreversible changes during cellular differentiation.

Technique:
• Use adult, differentiated nucleus to generate frog
Skin is 6697/6700 X 100 % differentiated skin

Gurdon conclusions

Goal:
• To determine whether nuclei undergo irreversible changes during cellular differentiation.

Technique:
• Use adult, differentiated nucleus to generate frog

Major questions:
• Was it an adult (donor) nucleus?--YES
• Was it a differentiated nucleus?--YES
• Did it generate a frog?--YES

Conclusion: after differentiation, there is:
• No loss of information
• No irreversible inactivation
• No permanent change in genes required for normal development.
**In situ hybridization**

- Alkaline phosphatase enzyme
- Antibody to biotin
- Biotin
- Probe complementary to **myoD** mRNA, having biotin residues on its uridines

**myoD** mRNA

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**miR-1**

**miR-206**
2.1 Developmental history of the leopard frog, *Rana pipiens*

2.2 Early development of the frog *Xenopus laevis* (Part 1)
2.2 Early development of the frog *Xenopus laevis* (Part 2)

2.3 Continued development of *Xenopus laevis* (Part 1)
2.3 Continued development of *Xenopus laevis* (Part 2)

(G) Dorsal

Notochord

Neural tube

Somite

Archenteron

Yolky endoderm

Epidermis

Ventral

Mesoderm

2.3 Continued development of *Xenopus laevis* (Part 3)

(H) Somites

Brain

Gill area

Expansion of forebrain to touch surface ectoderm

Stomodeum

Tailbud

(l)
2.5 Summary of meiosis (Part 1)

Meiosis I: Separation of homologous chromosomes

- Nuclear envelope
- Chromatin
- Homologous chromosomes
- Homologous chromatids

- Interphase
- Early prophase I
- Mid prophase I
- Late prophase I

DNA replicates

2.5 Summary of meiosis (Part 2)

- Metaphase I
- Anaphase I
- Telophase I

The two original homologous chromosomes are segregated into different cells
2.5 Summary of meiosis (Part 3)

Meiosis II: Separation of the chromatids

Metaphase II:  \[\text{an image of a cell in metaphase II}\]

Anaphase II:  \[\text{an image of a cell in anaphase II}\]

The kinetochore splits

Telophase II:  \[\text{an image of a cell in telophase II}\]

Each new cell has one copy of each chromosome

2.6 Representatives of the order Volvocales

(A)  \[\text{an image of a Volvox cell}\]

(B)  \[\text{an image of a Volvox cluster}\]

(C)  \[\text{an image of a Volvox cell in detail}\]

(D)  \[\text{an image of a Volvox cluster in detail}\]

(E)  \[\text{an image of a Volvox cell in detail}\]

(F)  \[\text{an image of a Volvox cluster in detail}\]
2.10 Life cycle of Dictyostelium discoideum

http://www.sciencemag.org/cgi/reprint/325/5945/1196.pdf
2.12 The three cell adhesion molecules of Dictyostelium

(A)  
(B)  
(C)