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1952 physics model describes feather bud formation observed in vitro

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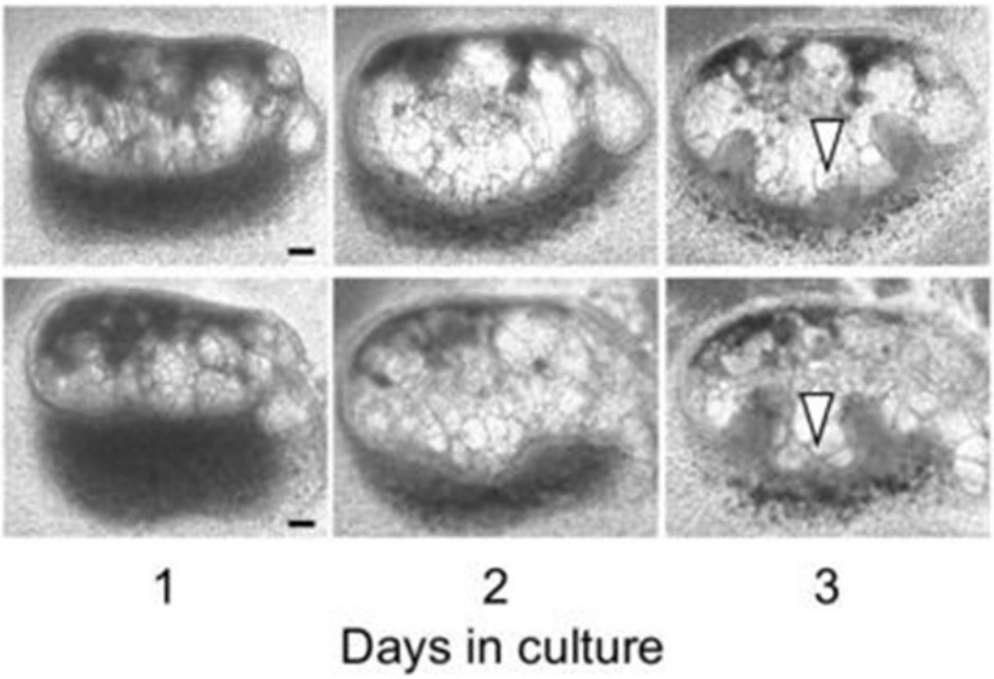
Researchers investigate role of boundaries and self-organizing processes in feather bud formation.



Skin self-organization and natural, "genetically mapped" boundaries may be an important feature in bioengineering and regenerating skin appendages, such as feathers. Like other skin

appendages, teeth, hair or even lung tissue, feathers are developed via interactions between the epithelium and the mesenchyme — mesodermal embryonic tissue — during early stages of morphogenesis. Authors of an article in *APL Bioengineering* describe their experiment evaluating pattern formation in feather buds growing in vitro, employing Turing's model, a "two reaction-diffusion model" published in 1952. The work advances the hypothesis that patterns during embryonic development respond to spatial biochemical pre-patterning.

Turing hypothesized that patterns seen in nature reflect underlying biochemical signaling. Similarly, the researchers found that a boundary effect guided the formation and patterning of feather buds in chicks. The formation they used its numerical description used a standard two-component reaction model.

Feather bud morphological features changed dramatically during the first two days of incubation as well as from days 0-4. Prime locations for feather bud formation were near the skin edges, a boundary edge that may function as a wall guiding the self-organization as bud formations occur at predictable sites from skin edges.

Co-author Toshiyuki Mitsui said their results revealed high

sensitivity to the size and shape of edges of bioengineered tissue composed of uniformly distributed homogeneous cells. This observation, he said, provides potential templates for studying the self-organizing processes in advancing regenerative medicine.

In the future, they will try to grow human hair using induced pluripotent stem cells (iPSCs), stem cells that can be generated directly from adult cells. The researchers said there may be an optimized geometry for each organ to regenerate from iPSCs.

Source: "Role of the boundary in feather bud formation on one-dimensional bioengineered skin," by Kentaro Ishida and Toshiyuki Mitsui, *APL Bioengineering* (2018). The article can be accessed at https://doi.org/10.1063/1.4989414.