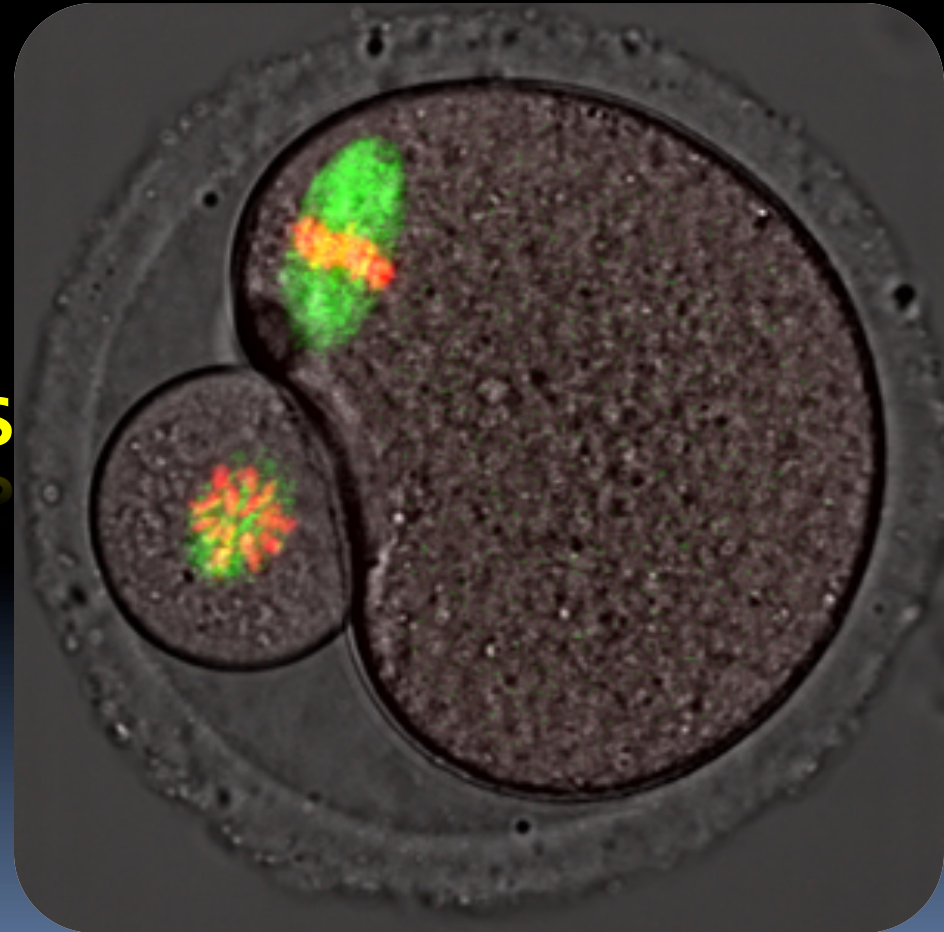




Biotechnology of Reproduction

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BIOLOGY OF GAMETES, IVM AND IVF TECHNIQUES



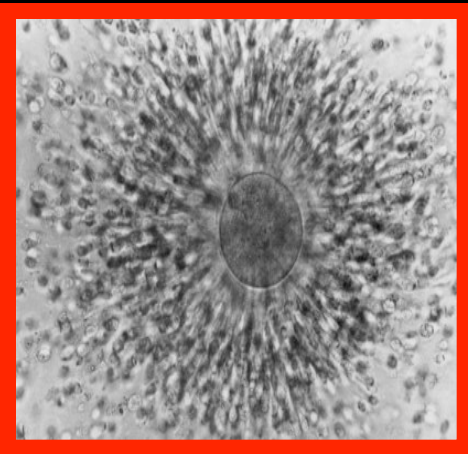


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THE BIOLOGY OF GAMETES

Prof. Luisa Gioia



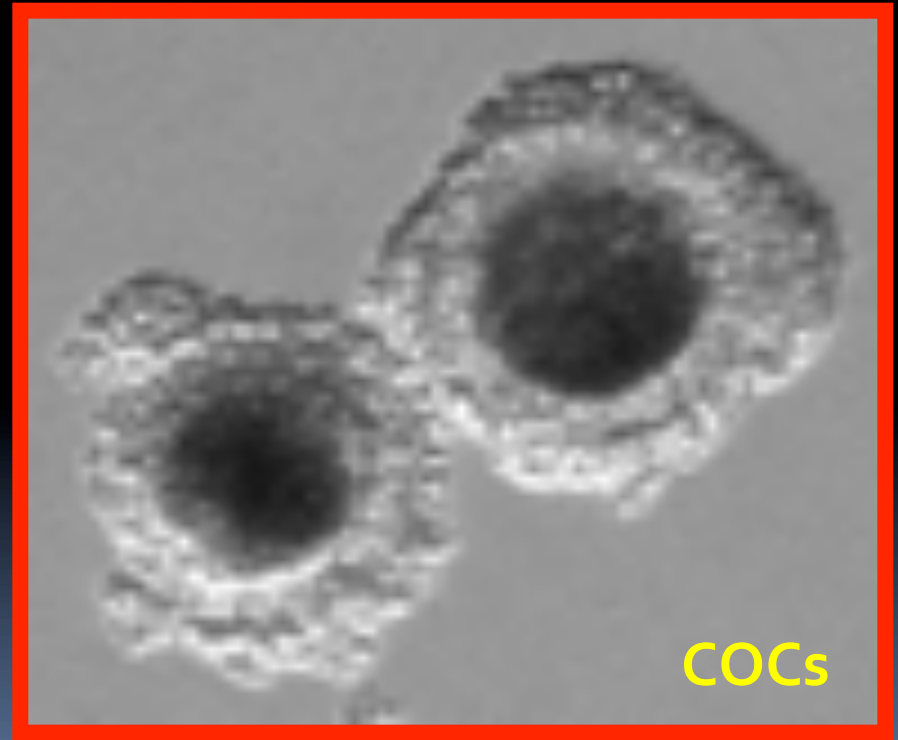


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THE OOCYTE

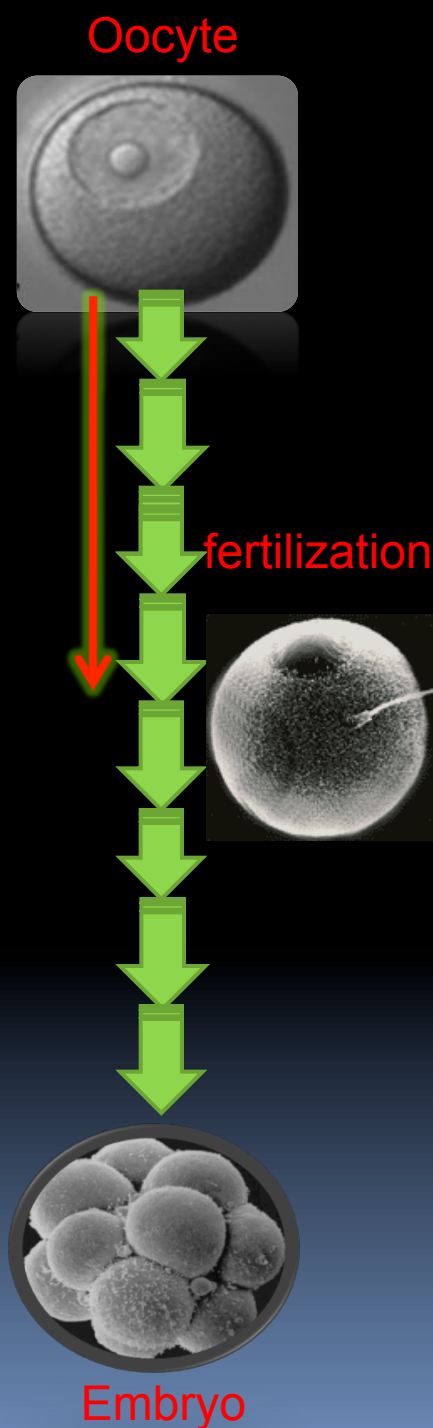
THE OOCYTE



OOCYTE:
differentiated cell

The oocyte is the only cell in the organism able to turn from a highly specialized cell to a totipotent one (the embryo)

EMBRYO:
totipotent cell

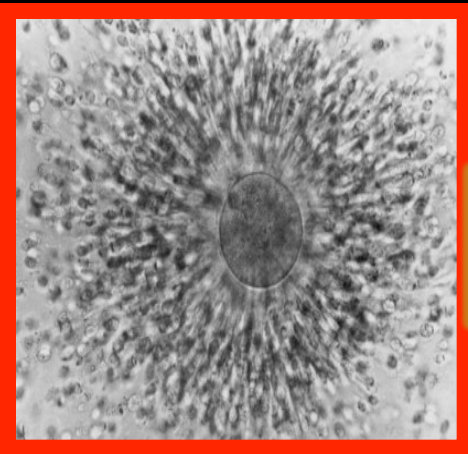




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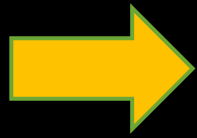
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BIOLOGY OF GAMETES



**OOCYTE
MATURATION**

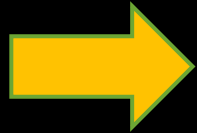
Unit 1: Biology of gametes



THE OOCYTE MATURATION

- ◆ ***Definition***
- ◆ *What is the purpose of the process?*
- ◆ *What triggers the process?*
- ◆ *How long is the process?*
- ◆ *What happens to the oocyte during maturation?*

THE OOCYTE MATURATION



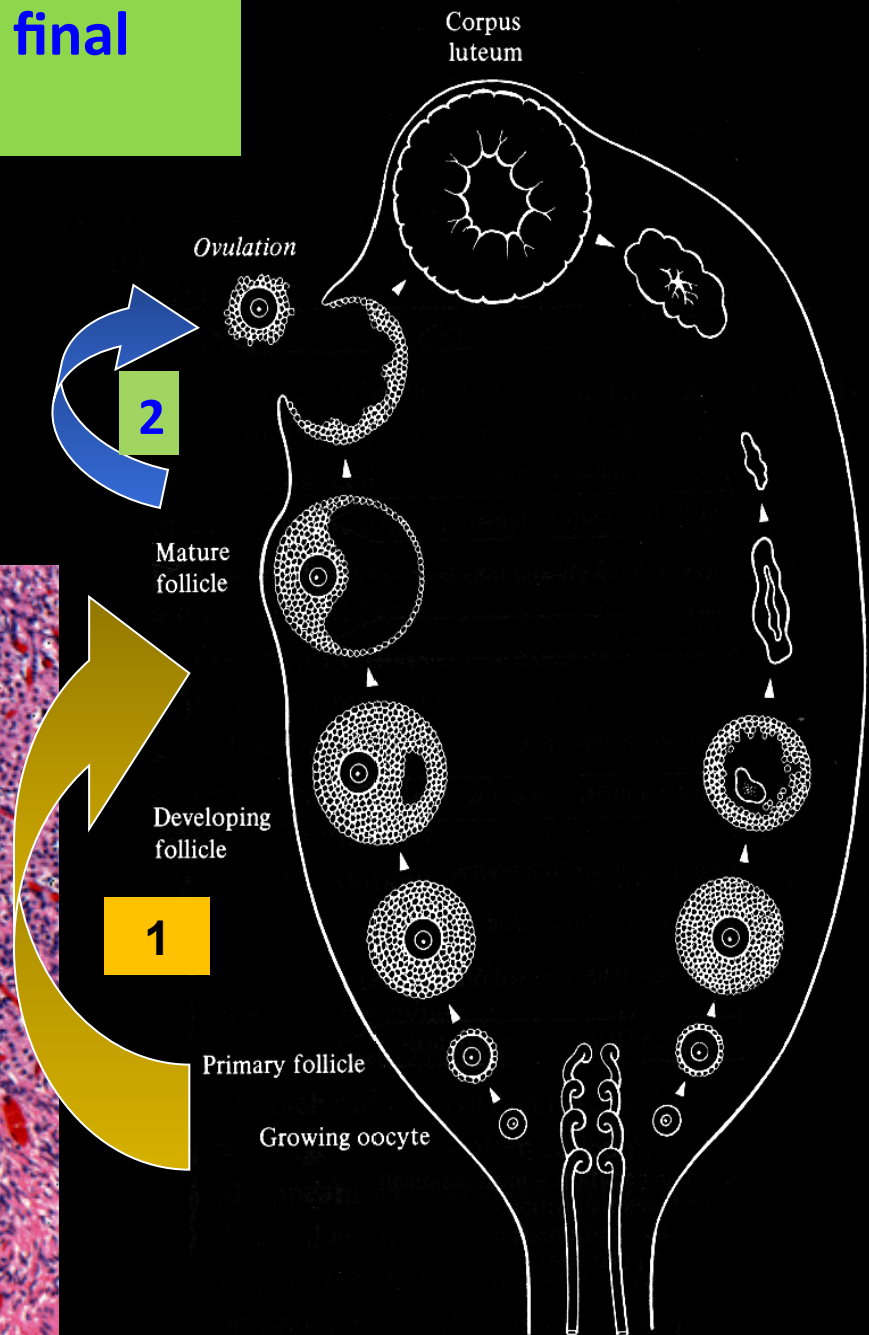
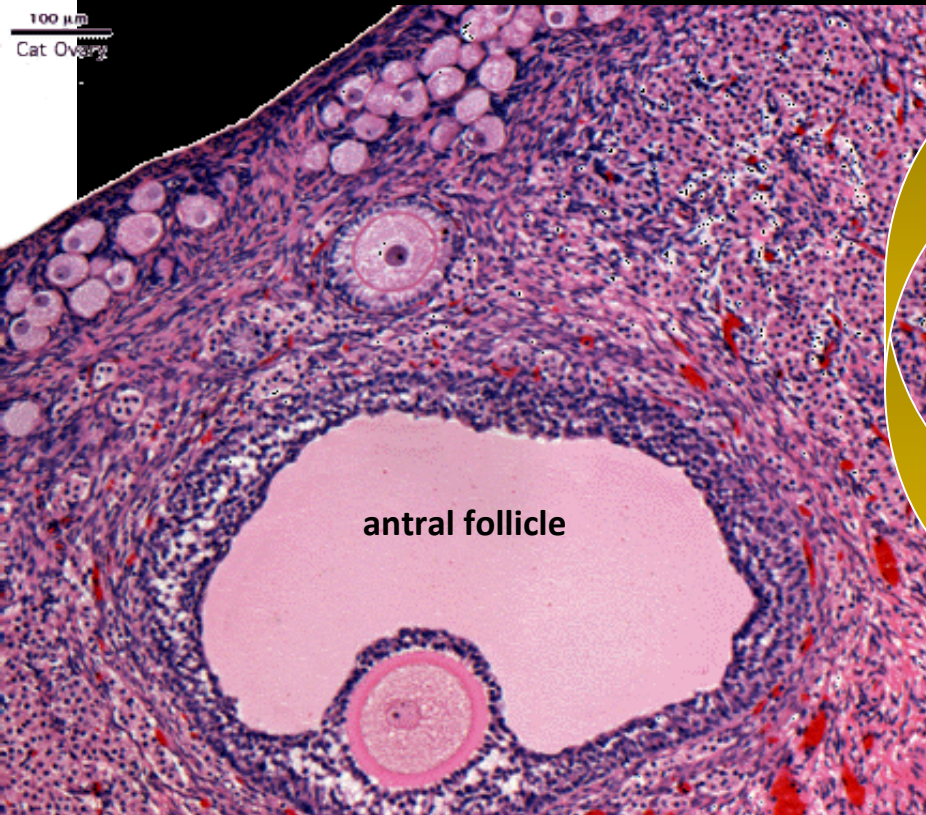
*DEFINITION:
What is “oocyte
maturation”?*



*What is the purpose
of the process?*

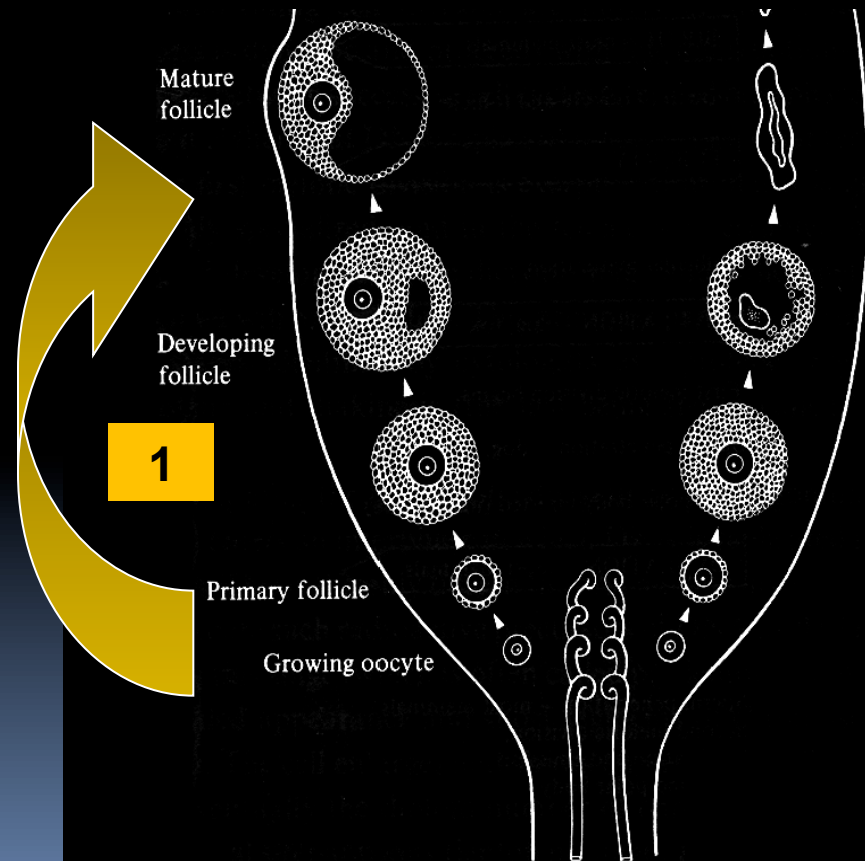
The oocyte maturation is the final phase of the oogenesis

100 μm
Cat Ovary



1) GROWTH PHASE

The oocyte has previously experienced a long period of growth realized inside the ovary, in parallel with the follicle growth and development (1)



1) GROWTH PHASE

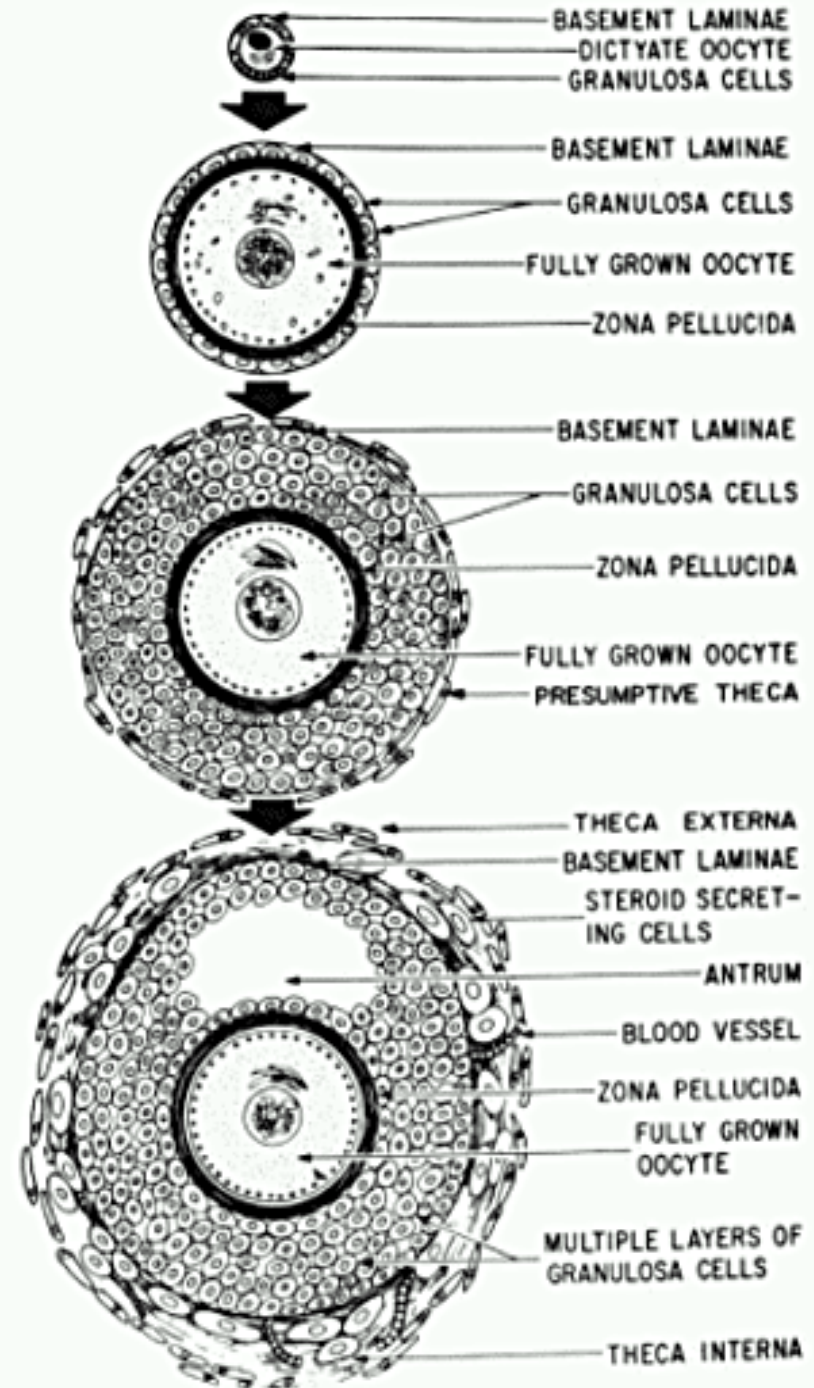
Folliculogenesis/ oogenesis

PRIMORDIAL
FOLLICLE
40 μ m

PRIMARY
FOLLICLE
100 μ m

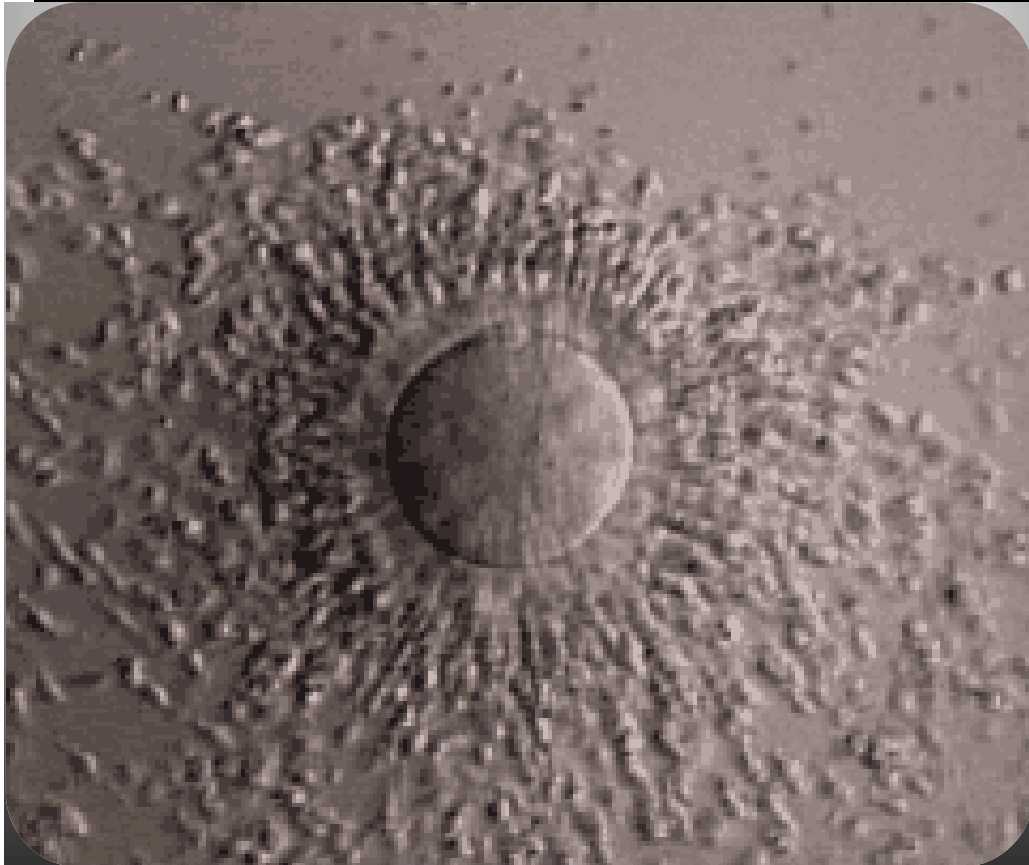
SECONDARY
FOLLICLE
200 μ m

EARLY
TERTIARY
FOLLICLE
400 μ m



Oocyte growth occurs in part due to the inherent synthetic capability of the oocyte but also because material is incorporated from surrounding pre-granulosa cells

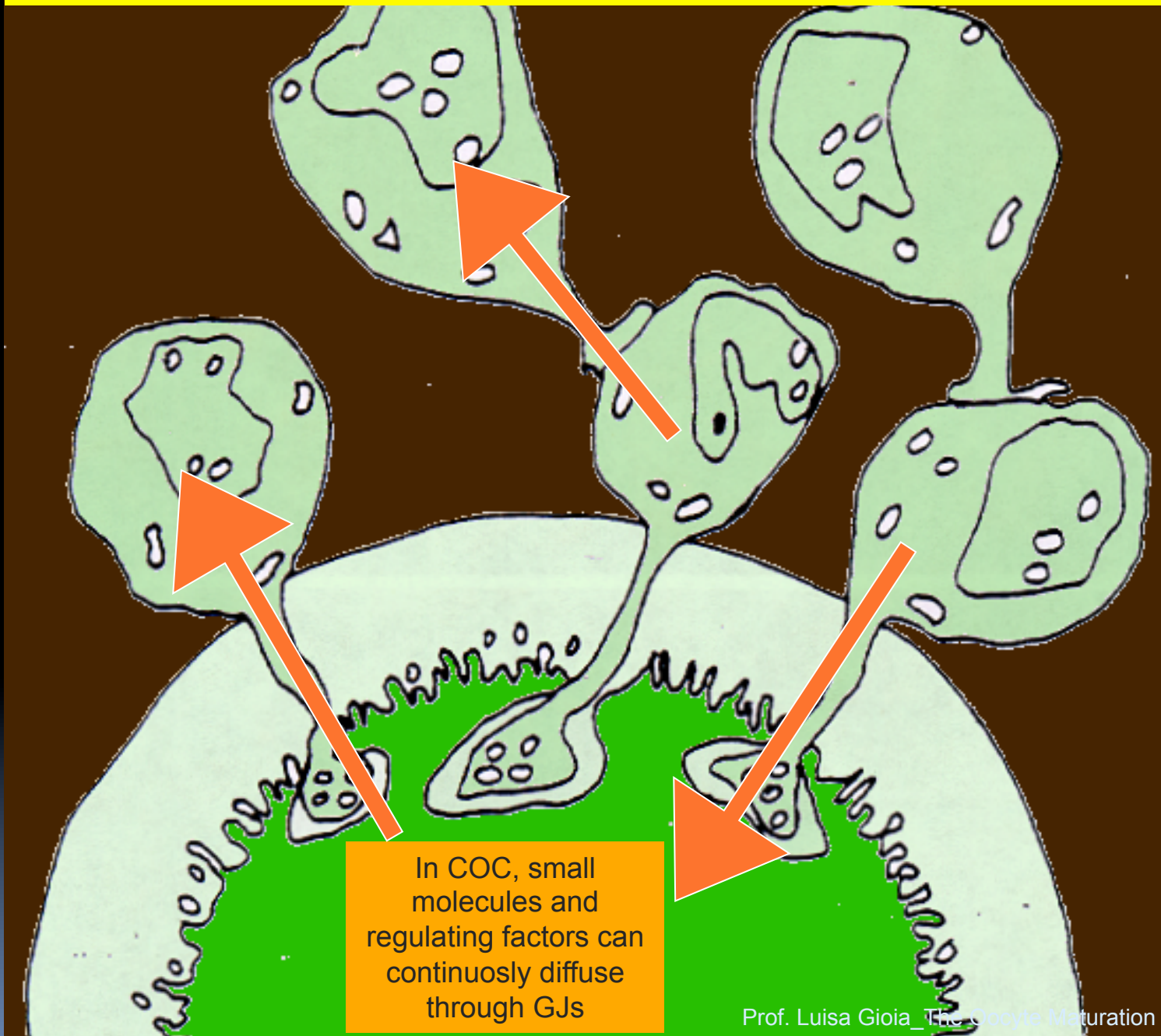
oocyte-follicle cells
COUPLING



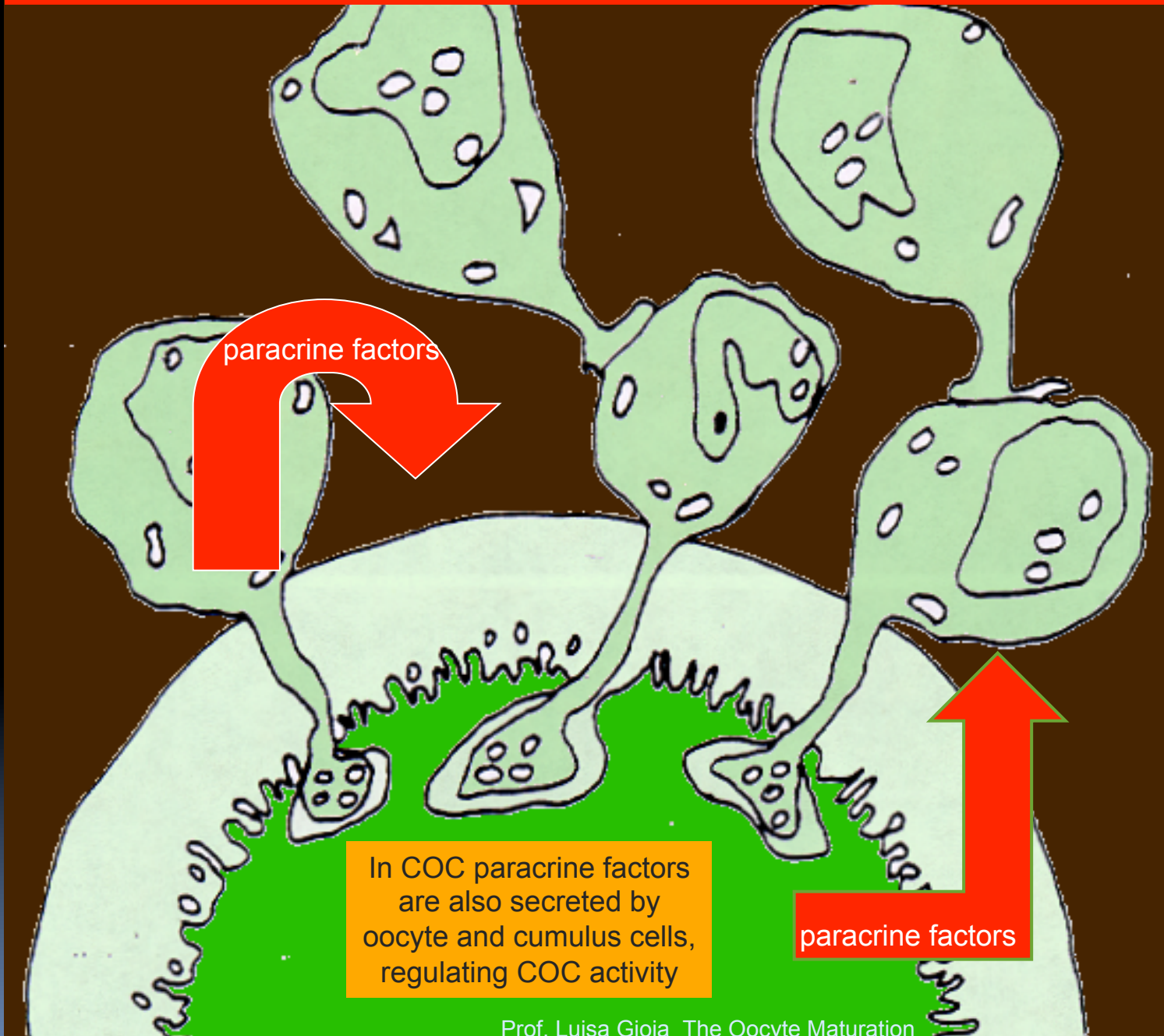
Incorporation is not impeded by the **ZP**, thanks to the presence of specialized junctions (**GJs**)

Bi-directional communication
and regulation

Gap junctions in the cumulus-oocyte complex (COC)



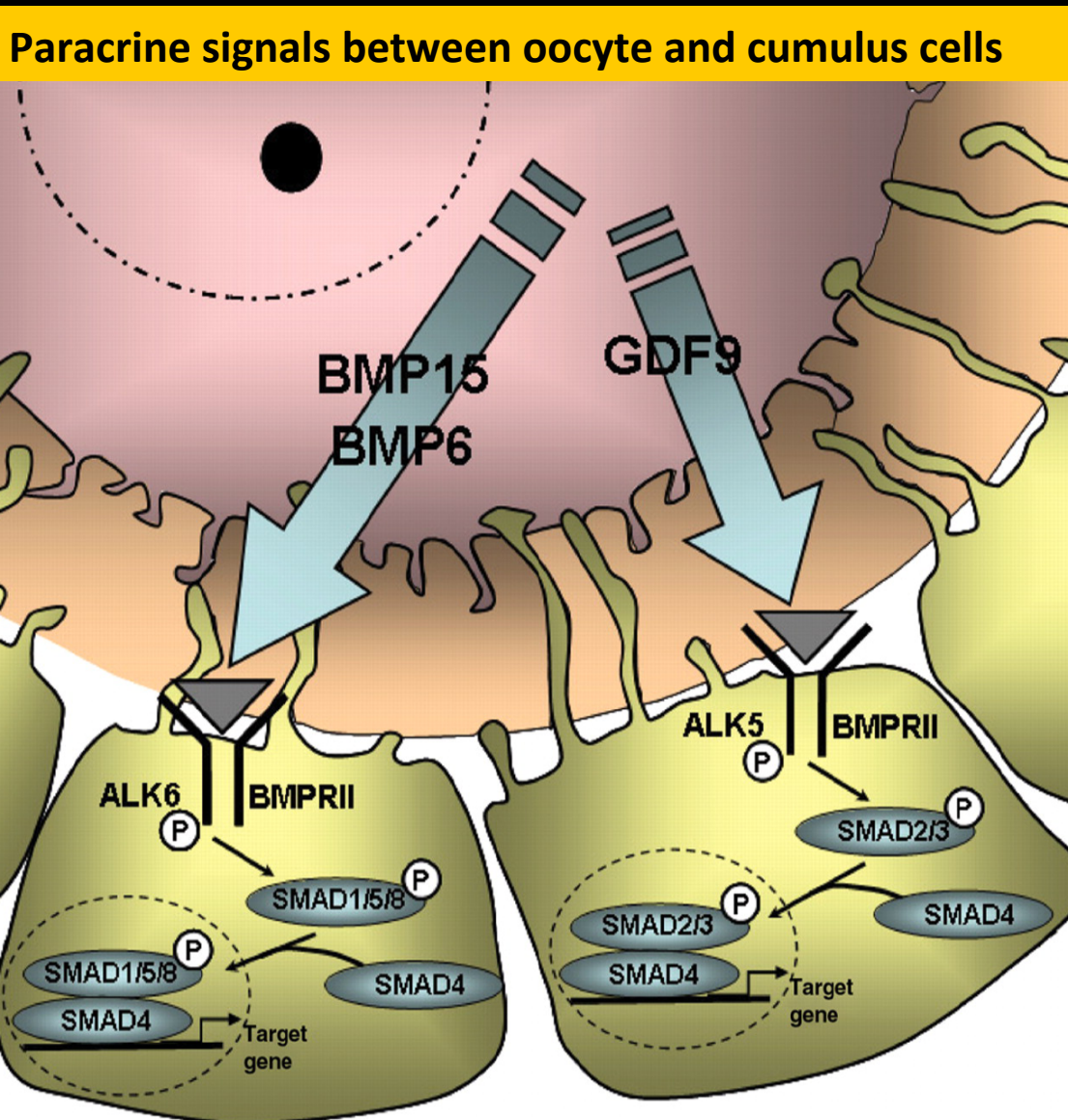
Paracrine signals between oocyte and cumulus cells (CCs)



In COC paracrine factors are also secreted by oocyte and cumulus cells, regulating COC activity

paracrine factors

The oocyte can regulate the proliferation, gene expression and function of CCs.
So, it can direct its growth by influencing its microenvironment

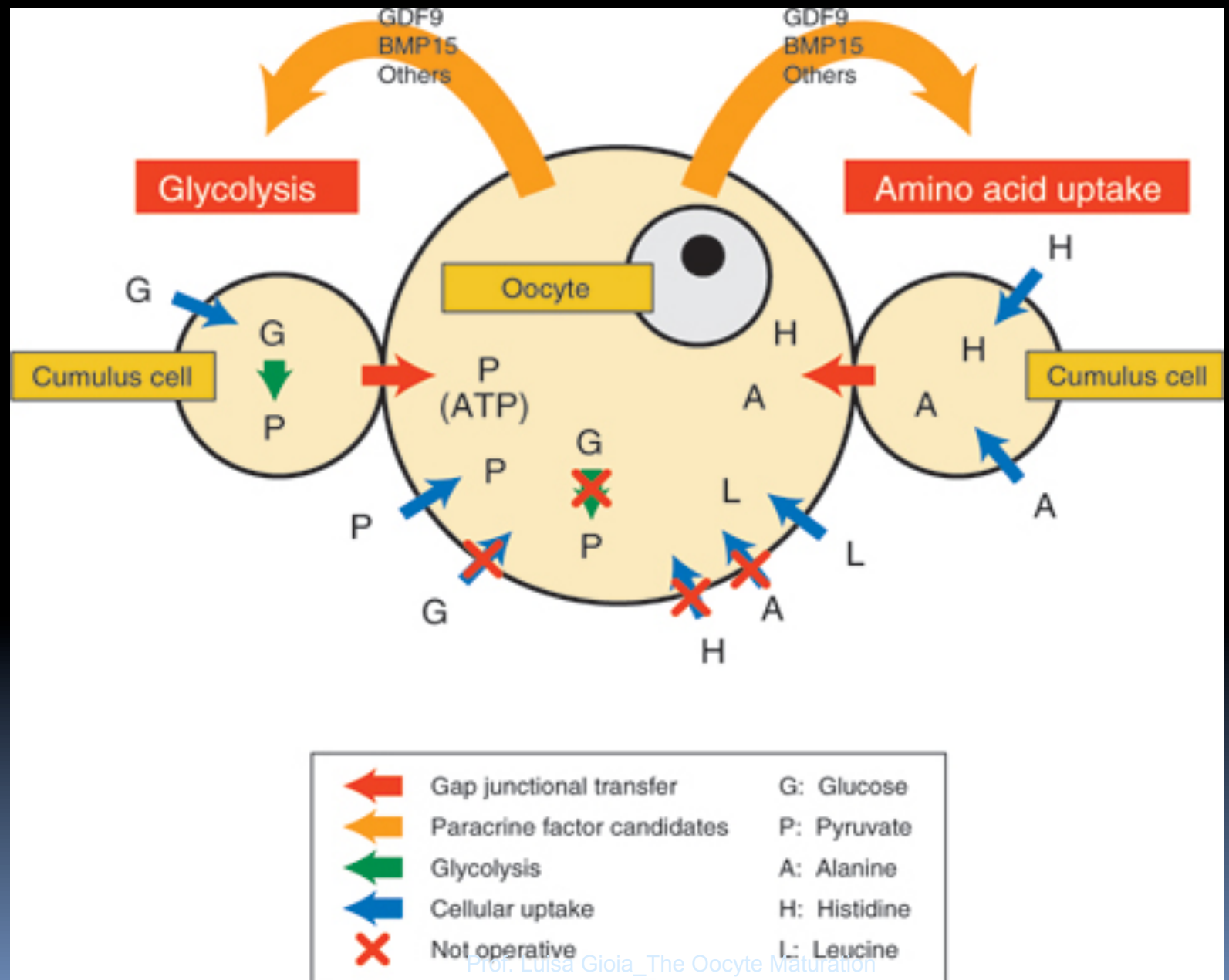


BMP15 and GDF9 are expressed in an oocyte-specific manner from a very early stage

They play key roles in promoting follicle growth beyond the primary stage

Reference: Gilchrist, R. B. et al. *Hum Reprod Update* 2008

Nutritional support from CCs is essential for growth and development of the oocyte





Pay attention!

- The oocyte growth and maturation are processes strongly dependent on the relationship between the gamete and the surrounding somatic cells

A functional coupling between the oocyte and the CCs exists and this relationship is fundamental throughout both oocyte growth and maturation

Bidirectional communication between mammalian oocytes and their associated follicular somatic cells (cumulus cells) is essential for development of both cell types

(Eppig, 2001)

Communication between oocyte and granulosa cells (GCs)

Via both GJs and secreted paracrine signals

GCs:

- Promote growth and development of the oocyte and acquisition of competence to resume meiosis
- Cause the maintenance of meiotic arrest in fully grown oocytes
- Participate in the induction of meiotic resumption after the pre-ovulatory surge of LH

The oocyte:

- Promotes the formation of primordial follicles
- Promotes GCs proliferation
- Promotes cumulus expansion
- Regulate GCs differentiation and function



Take home message



IVM techniques:

The intimate relationship between oocyte and follicle cells extends from follicle formation to ovulation and affects the development and function of both cell types.

Isolated oocytes do not properly mature in culture without their companion somatic cells!!!!

COUPLING in pig COC during *in vivo* or *in vitro* maturation

