

# *Histology and Embryology*

## *Periodical*

*Department of Histology and Embryology*  
*Third Medical Faculty, Charles University in Prague*

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### **What's up...?**

In the month of March, we have acquired a better understanding of both, male and female reproductive systems. Earlier this month, you experienced a lecture on the subject, and currently you have been exercising your theoretical knowledge in group practices.

The lecture about gametogenesis and fertilization was meant to help you in understanding the microscopic structure of the key organs in the processes. Gametogenesis takes place in gonads thus we focus our attention primarily on ovary and testis, their structure and function.

However, in the course of our practices you have had the occasion to make yourself familiar with several other organs both, in theory and on histological slides. The organs and tissues include specifically those prone to pathological reactions such as prostate and endometrium of the uterus.

### **Reminders...**

Don't forget your opportunity to start viewing slides for semestral testing! Your exams seem far, far ahead however, time flies!

On Monday and Wednesday afternoons, there are experienced and enthusiastic histological assistants ready to help and counsel you!

The number of microscopes are limited and as the end of summer semester advances it might get very difficult to find the necessary peace and place to study for your slide examining!

We look forward to seeing you!

**Mondays & Wednesdays,**  
**3,15 – 4,45 pm,**  
**room no 319!!!**

*„The longer you look, the more you see!“*

## Birth defect awareness month

In the USA, January 2014 was Birth Defect Awareness Month announced by the National Birth Defect Prevention Network. The event was intended for both, health care professionals and the public, to remind of the basic facts that birth defects are;

**COMMON** – one in 33 U.S. babies is born with a major birth defect each year, in other words every 4 ½ minute a baby is born with birth defect in the U.S.

**COSTLY** – the yearly hospital costs for birth defects exceed \$2.6 billion.

**CRITICAL** –1 in 5 infant deaths is due to birth defects, making them a leading cause of infant mortality.<sup>1</sup>

**Q: What is the most common birth defect?**

**A:** Defects in the formation of the heart are the most common birth defects and are recognized in about 15% of infants with birth defects.<sup>2</sup>

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<sup>1</sup> Birth Defect Prevention Network, 2014. Birth Defect Prevention Month 2014. Birth defects are common, costly, and critical [online]. [Cit. 26 February 2014]. Available from: <http://www.nbdpn.org/bdpm2014.php>

<sup>2</sup> Teratology society, 2010. Teratology primer, second edition [online]. 9 July 2010 [Cit. 15 February 2014]. Available from: <http://connection.teratology.org/p/cm/ld/fid=6>

## What do you remember... ...about epithelia:

Epithelium is among the **four basic types of tissue** ..... along with; connective, muscle and nerve tissue.

There are three principal characteristics for the cell of epithelium; the specialized **cell junctions** in between closely apposed cells, each of the cell **poles** (apical, lateral and basal) is unique in its' function and associated with a specific morphology, and the basal surface is always attached to a **basement membrane**.

Epithelium of the vessels is called... **endothelium**.

Epithelium inside the heart is called... **endocardium**.

Epithelium of the body cavities is called... **mesothelium**.

**Epithelioid tissue**, i.e. epithelium-like, is such an organization of epithelial cells that these lack a free surface. The epithelioid cells are derived, in most cases, from progenitor mesenchymal cells. Examples of epithelioid tissue are typically some endocrine glands such as interstitial cells of Leydig in testis, or the lutein cells in ovary.<sup>3</sup>

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<sup>3</sup> Ross, Michael H. a Pawlina, Wojciech. Histology: a text and atlas: with correlated cell and molecular biology. 6. vyd. Baltimor, MD USA: Lippincott Williams & Wilkins, a Wolters Kluwer business, 2011. ISBN: 978-0-7817-7200-6.

**Q: What is the cell origine of the islets of Langerhans in pankreas?**

*A: Dig deeper and find out... important!*

## **Histones as possible keyholders to totipotent stem cells<sup>4</sup>**

In 1962 Dr. John B. Gurdon changed the then prevalent view that mature cells are permanently locked in their differentiated states, unable to return to a fully immature, pluripotent stem cell state. Demonstrating that the nucleus from a differentiated frog intestinal epithelial cell was capable of generating a fully functional tadpole upon transplantation to an enucleated egg, Dr. Gurdon has started the time of wonders in the cloning world.

Moreover, in 2006 Shinya Yamanaka came with an astonishingly simple procedure how to revert a cell to its' pluripotent state introducing as little as four transcription factors into a differentiated cell. The resulting cell was called induced pluripotent stem cell (iPSC).

Both, Dr. Gurdon and Dr. Yamanaka were awarded with the 2012 Nobel Prize in Physiology and Medicine.

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<sup>4</sup> RIKEN. Histones may hold the key to the generation of totipotent stem cells [online]. ScienceDaily, 6 February 2014. [Cit. 15 February 2014]. Available from: [www.sciencedaily.com/releases/2014/02/140206133644.htm](http://www.sciencedaily.com/releases/2014/02/140206133644.htm)

*Nanos gigantum humeris insidentes*, a team of dr. Shunsuke Ishi ventured to identify a molecule in the mammalian oocyte that would induce the complete reprogramming of the genome leading to the generation of totipotent embryonic stem cells <sup>5</sup>.

Dr. Ishi and his team chose to focus on two histone variants; TH2A and TH2B, known to be specific to the testes, bind there tightly to DNA and affect gene expression. In early embryo, TH2A and TH2B bind to DNA and induce and open chromatin structure in the paternal genomem by that contributing to its activation after fertilization.

The study published in the journal *Cell Stem Cell* demonstrates that when added to the four Yamanaka transcription factors, TH2A and TH2B increase the efficiency and speed of the iPSC.

Dr. Ishi explains that „TH2A and TH2B in combination enhance programming because they introduce a process that normally operates in the zygote during fertilization ..., and lead to a form of reprogramming that bears more similarity to oocyte-based reprogramming and [the cloning technique called] SCNT [somatic-cell nuclear transfer].“

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<sup>5</sup> Shinagawa T, Takagi T, Tsukamoto D, Tomaru C, Huynh LM, Sivaraman P, Kumarevel T, Inoue K, Nakato R, Katou Y, Sado T, Takahashi S, Ogura A, Shirahige K, Ishii S. Histone Variants Enriched in Oocytes Enhance Reprogramming to Induced Pluripotent Stem Cells. *Cell Stem Cell* **14** (2), 217-227. Available from: <http://www.sciencedirect.com/science/article/pii/S193459091300564X>

**Q: What is a histone?**

**A:** *To make a very long story very short; histones are proteins found in the nuclei of eukaryotic cells to organize the DNA into nucleosomes. They are in fact the main protein components of chromatin.*

*There are five major families of histones.*

*Speaking of their function; histones work as spools to compact DNA strands and play an important role in chromatin regulation.*

Warning: be aware that this short intro about histones is highly insufficient for your own answers in Module Cellular basis of Medicine/Module CELL.

**Q: What is the difference between totipotent and pluripotent cells.**

**A:** *Why don't YOU find out?*

## Eponyms

### **„Crypts of Lieberkühn“**

**Johann Nathanael Lieberkühn** is an 18th century physician, born and died in Berlin, Germany. Although he originally studied theology, and later physics (particularly fond of mechanics), those were the sweet times when changing your mind towards medicine was done with little opposition. Besides an accomplished physician, Dr. Lieberkühn became famous for his medical specimen, so well done that some were still presented in the next century as masterpieces.

The epithelial glands in the small intestine named after him he described in – let's practice your Latine - *De fabrica et actione volorum intestinorum tenuium hominis*, in 1745.

Regarding our Swedish students, let's also mention that Dr. Lieberkühn was elected a foreign member of the Royal Swedish Academy of Science. Lucky enough to enjoy this honor, Johann Nathanael Lieberkühn died only a year later, in 1756.

<sup>6</sup>

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<sup>6</sup> Wikipedia Contributors, 2013. Johann Nathanael Lieberkühn. Wikipedia, The Free Encyclopedia. Date of last revision 28 February 2013 at 16:26 [cit. 18 February 2014]. Available from: [http://en.wikipedia.org/w/index.php?title=Johann\\_Nathanael\\_Lieberk%C3%BChn&oldid=541276327](http://en.wikipedia.org/w/index.php?title=Johann_Nathanael_Lieberk%C3%BChn&oldid=541276327)