**Maternal transmission of microbiome**

**HOW TO USE THIS RESOURCE**

Students struggle with synthesizing multiple pieces of information into one comprehensive evaluation of a problem and the numerous ramifications. This activity is meant to illustrate the multi-facet issues and multi-system consequences of vaginal versus cesarean section delivery of a baby to the baby’s health.

Provide the students the handout which includes the figure below and the background information. The handout can be made available either before class (e.g. posted on-line), during class as a handout, or by projecting the image and verbally explaining the background. The “Interpreting the Figure” and “Discussion Questions” sections provide suggestions on how to lead the class discussion about the information in the figure.



**Background information**

Although humans tend to think of themselves as single, stand alone, entities, we are actually a composite of our cells and those of our microbes (microscopic organisms, predominantly bacteria, termed microbiota). And although we tend to think of bacteria in a negative light, our microbes, particularly those inhabiting our digestive system, play critically important and complex roles in our body. When the gut microbiome is altered, humans experience medical disorders of the digestive tract. But, the influence of the gut microbiota transcends digestive disorders. Changes in gut microbiota are also linked to neurological and immune disorders.

So if our gut microbiota are so important, and if we are born without them, how do humans acquire them? In human birth, the first encounter with microbes occurs during the birth process as a soon to be newborn travels from the uterus, through the vagina, and out of the woman’s body. The mother gives the newborn exposure to her microbiota through her vagina. In a C-section, the baby is removed directly from the uterus without encountering the woman’s microbiota. How does being born via c-section affect the baby’s microbiota? Provide a specific, detailed answer, and cite any data used in the process of answering this question.

**INTERPRETING THE FIGURE**

*Teacher Tip: Prompt your students to see the connectedness between processes in the human body*

**DISCUSSION QUESTIONS**

1. What metabolic disorders do the digestive system microbiota (gastrointestinal (GI), gut microbiota) affect?

2. Do gut microbiota only affect the digestive system?

3. What are the consequences of an altered gut microbiota of a newborn to that baby? Knowing information about human circulatory, immune and nervous systems, can you hypothesize why altered gut microbiota would lead to disorders in other body systems?

4. C-sections can save lives, but many women choose elective (not medically needed)

c-sections. What reasons do you think are raised for elective c-sections? If a c-section is performed, how can the mother’s microbiota be provided to the newborn?

5. Beyond impacts to the newborn’s microbiota, can you speculate about some potential consequences of increased elective c-section rates in the United States?

**SOURCES**

Figure 1 from:

Moya-Pérez, A., Luczynski, P., Renes, I.B., Wang, S., Borre, Y., Anthony Ryan, C., Knol, J., Stanton, C., Dinan, T.G. and Cryan, J.F., 2017. Intervention strategies for cesarean section–induced alterations in the microbiota-gut-brain axis. *Nutrition reviews*, *75*(4), pp.225-240.

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