**Normal Development**

After birth, the infant gut is primarily colonized with Proteobacteria and Firmicutes, followed by a gradual increase in Actinobacteria with the introduction of breast milk.

Upon weaning, the abundance of carbohydrates in solid foods bring forth high abundances of Bacteroidetes as both Proteobacteria and Actinobacteria gradually decline.

By the end of the first year of life, the gut approaches an adult gut microbiome, dominated by Bacteroides and Firmicutes.

**Obesity**

Peptides (and other molecules) from commensals are recognized and help in the maturation and differentiation of B and T cells.

Pathogens crossing epithelial barrier are recognized and endocytosed by macrophages; immune system develops antibodies.

Dendritic cells periodically sample the lumen for commensals, enabling proper formation of IgA antibodies to prevent commensals from crossing the epithelium.

**Allergy, Atopic, and Autoimmune Diseases**

Antibiotics reduce biodiversity temporarily, affecting taxa not essential for immune development.

Antibiotics eradicate keystone taxa during a critical window of immune development.

Keystone taxa return and establish niche.

During recovery, abundances of dominant taxa fluctuate and microbial community restructures.

Microbiome reaches a new state of stasis with permanent differences in composition and metabolic capabilities.

Loss of keystone taxa prevents maturation and differentiation of B and T cells.

Immature immune system unable to produce IgA and antimicrobial peptides necessary for prevention of mucosal penetration by commensals.

Eventual exposure to keystone taxa allows for development of complete, yet impaired, immune system.

**Infectious Diseases**

Antibiotics reduce diversity in the gut, disrupting homeostasis at the epithelial layer, resulting in reduced mucin, cytokine, and AMP production.

Inflammatory gut environment and permanent compositional changes may lead to predisposition to chronic infections.

Permeable gut epithelium increases risk for translocation of pathobionts and pathogens.

Immune development proceeds as normal.

Loss of diversity displaces dominant taxa and enables blooms of pathobionts and pathogens.

Mucus