

Johns Hopkins Engineering

Immunoengineering

Allergy and Autoimmunity
Causes and Rise of Allergies

Development of Allergies

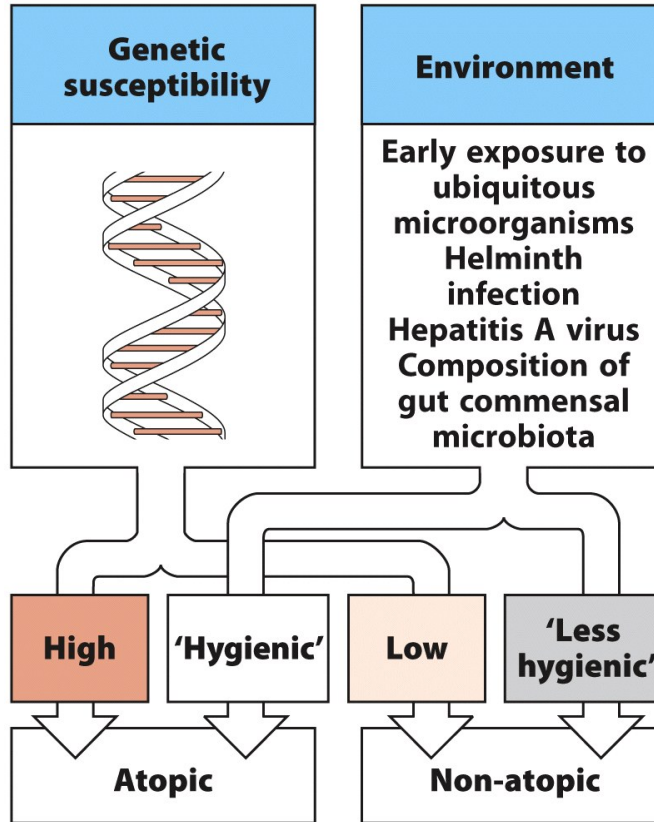


Figure 14.9 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Genetic Predisposition and Overlapping Risk Factors

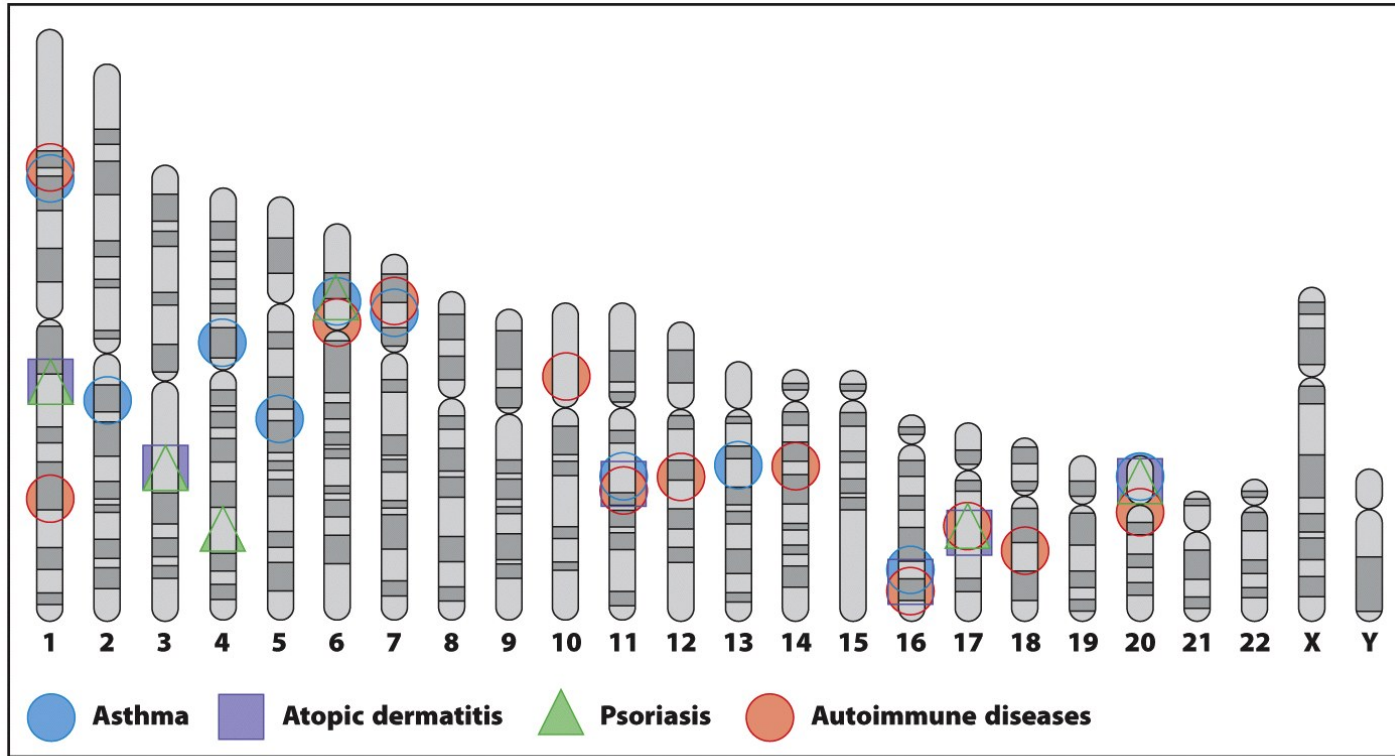
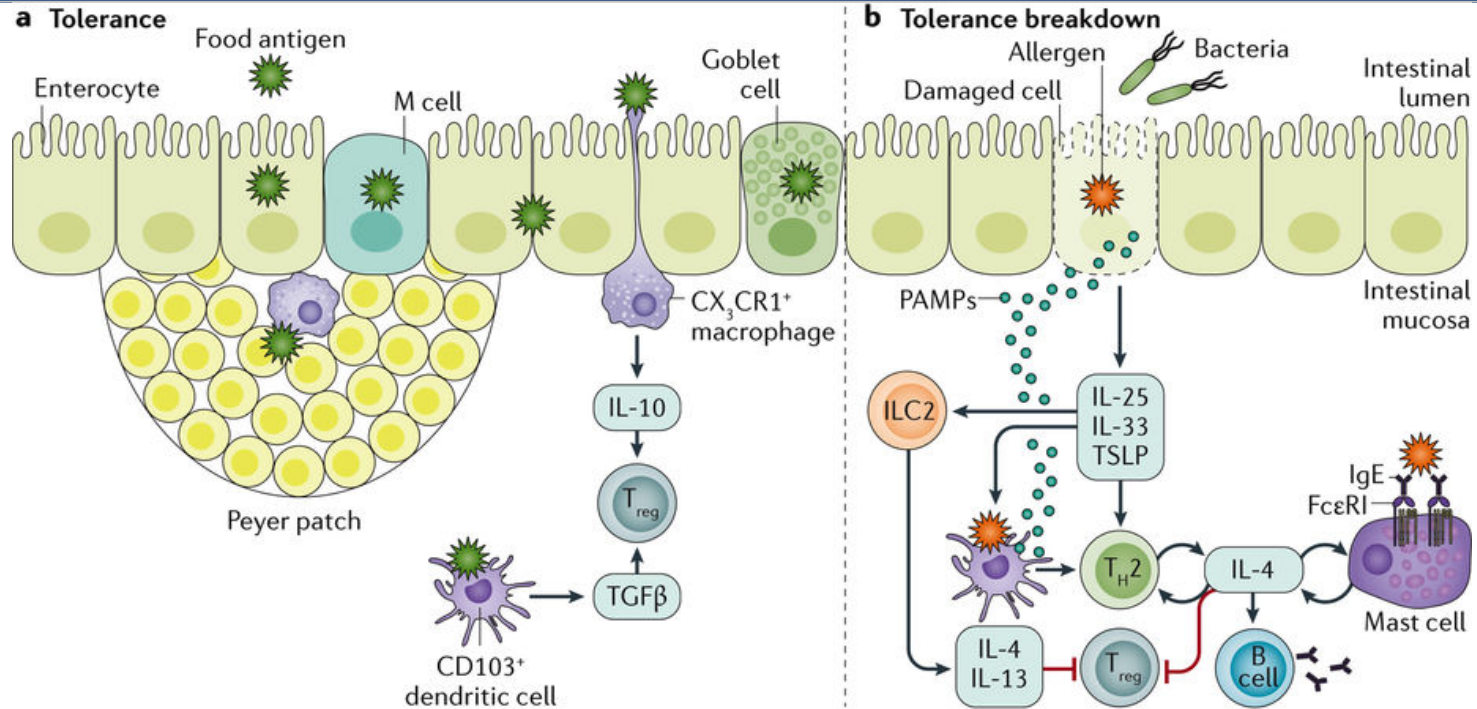


Figure 14.7 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Trauma Associated Allergies



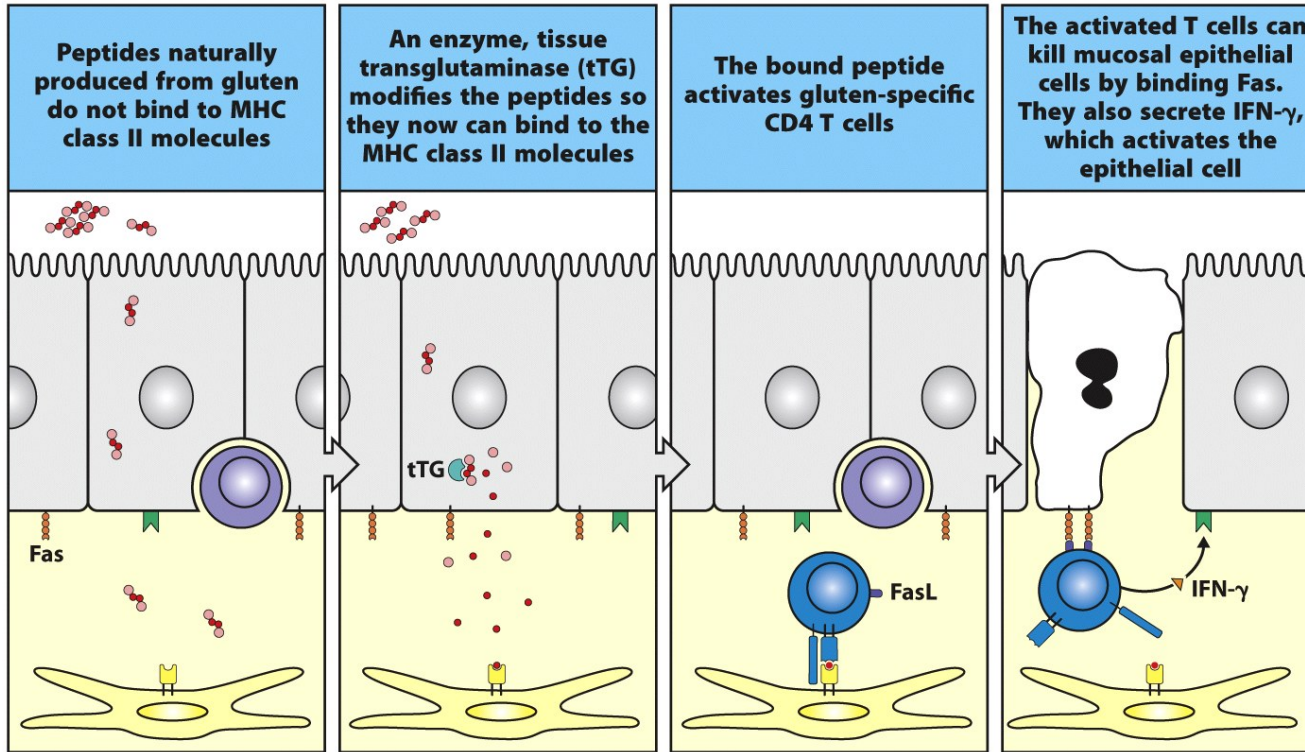
Risk Factors for Food Allergy Development

Immature mucosal immune system
Early introduction of solid food
Hereditary increase in mucosal permeability
IgA deficiency or delayed IgA production
Inadequate challenge of the intestinal immune system by commensal flora

Genetically determined bias toward a T_H2 environment
Polymorphisms of T_H2 cytokine or IgE receptor genes
Impaired enteric nervous system
Immune alterations (e.g., low levels of TGF-β)
Gastrointestinal infections

Figure 14.18 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Celiac's Disease Example



Genetic

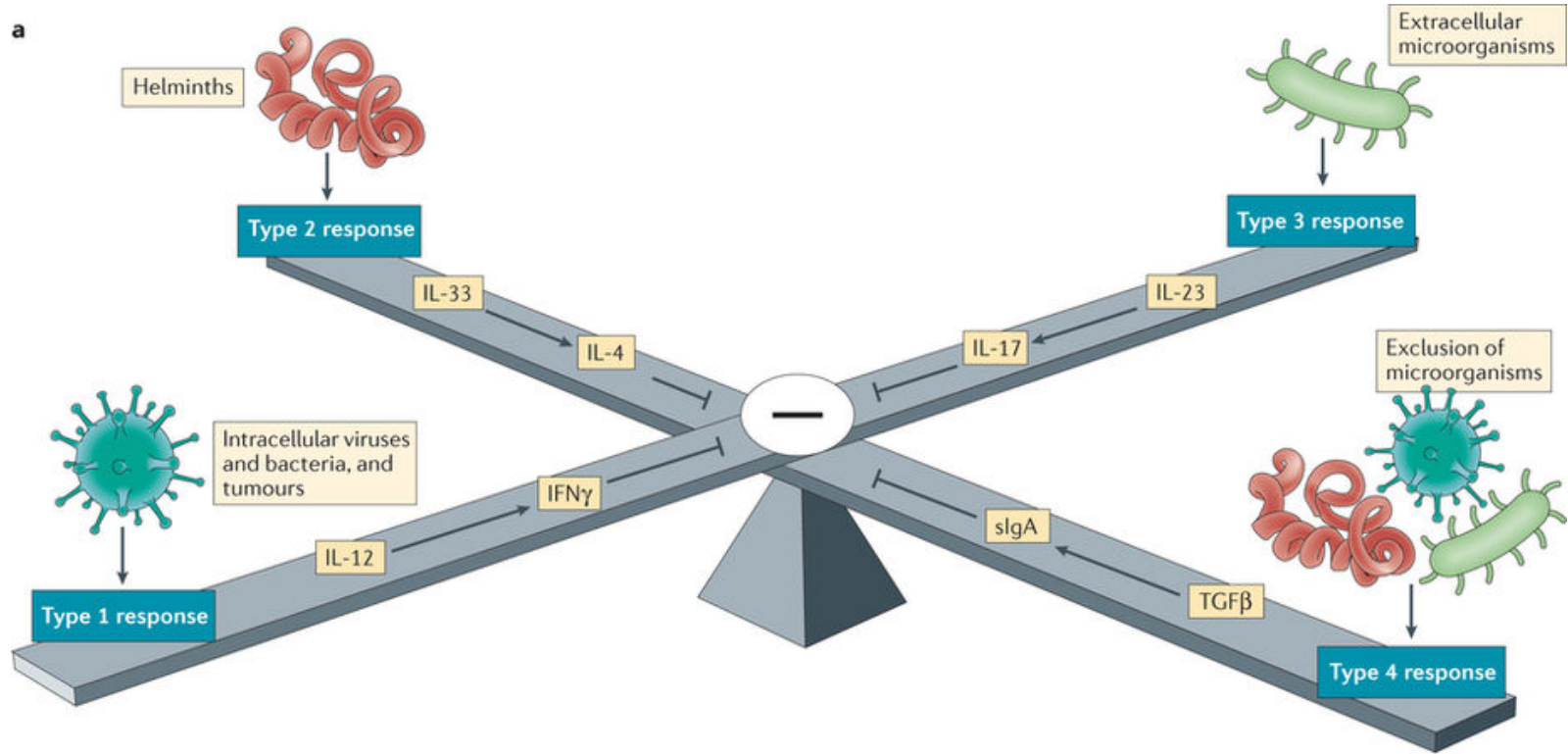
- HLA-DQ2
- CTLA-4
- tTG

Environment

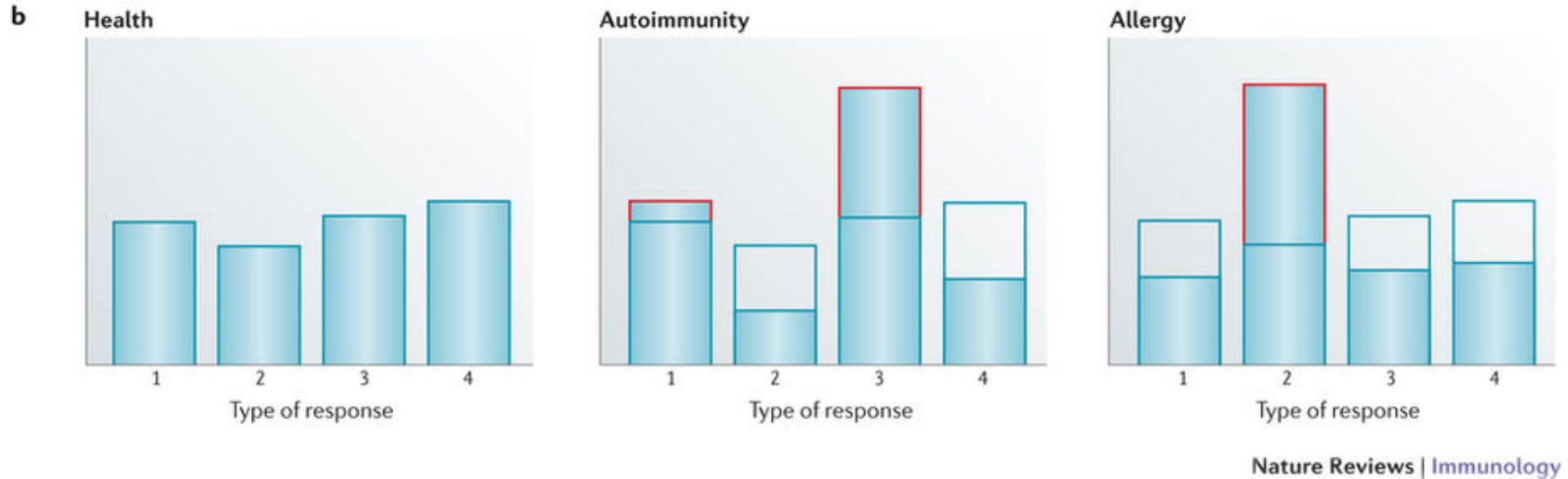
- Digestion
- Damage

Figure 14.28 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

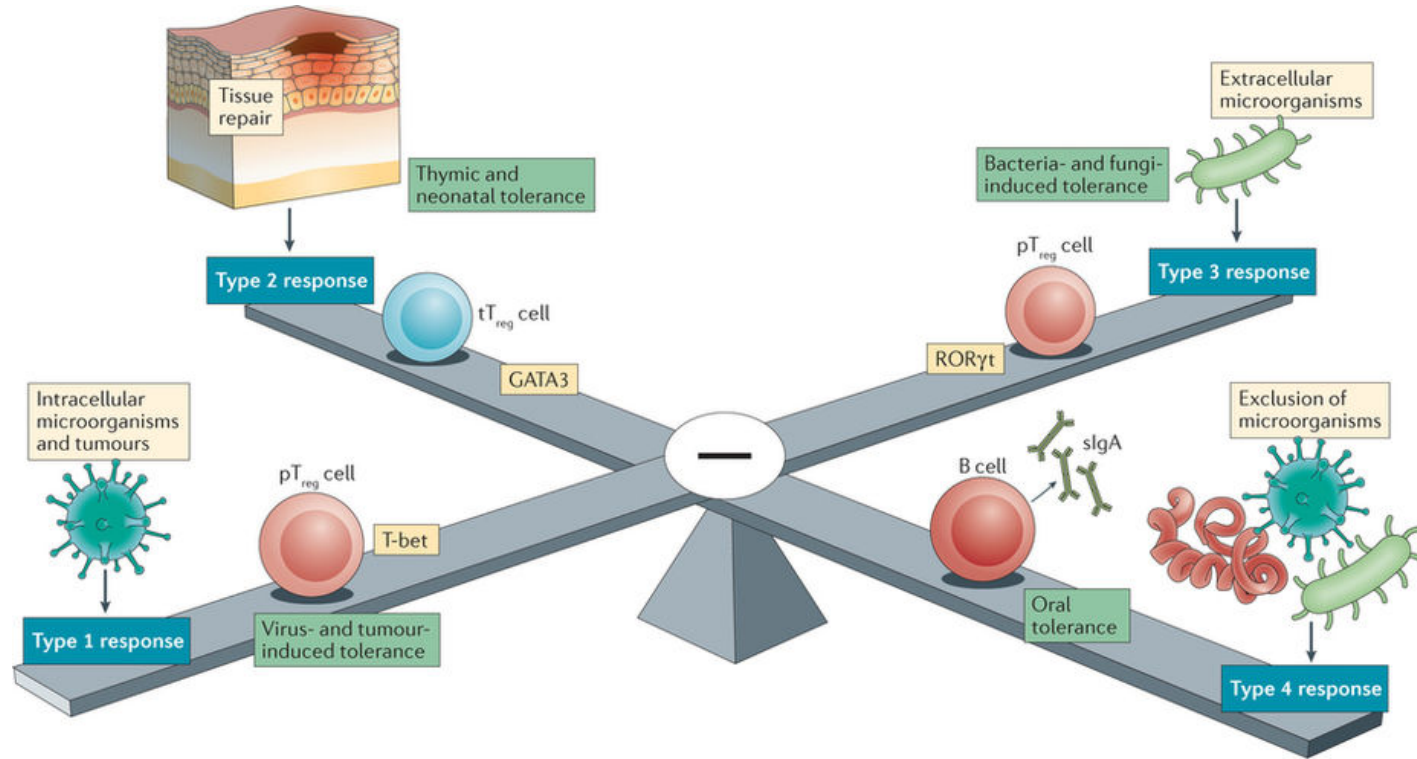
Equilibrium Hypothesis



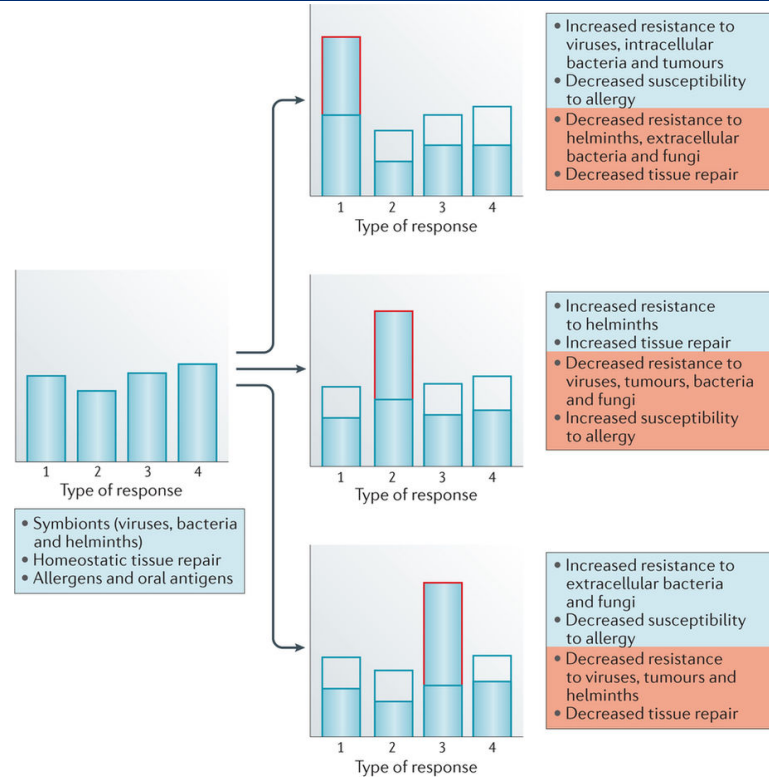
Equilibrium Hypothesis



Equilibrium Hypothesis

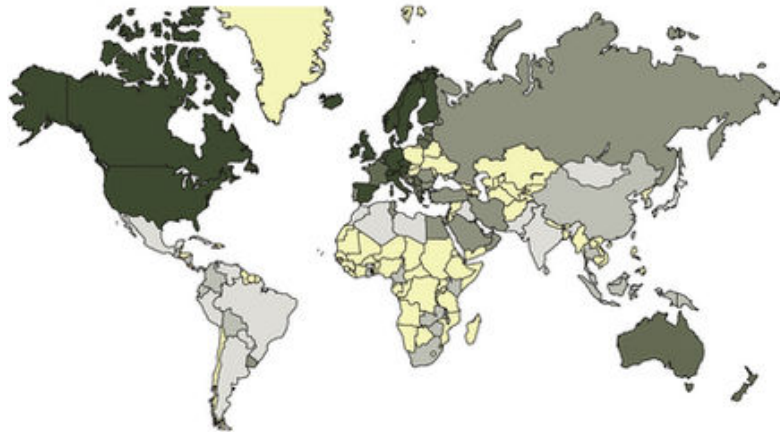


Equilibrium Hypothesis

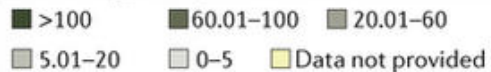


Autoimmunity Prevalence

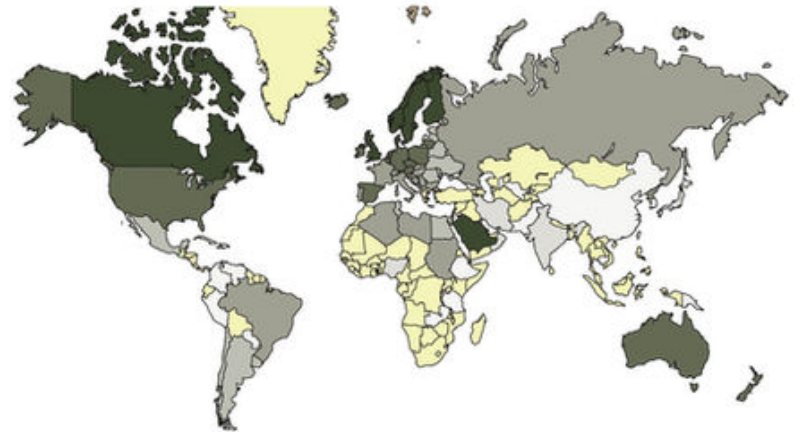
a Multiple sclerosis



Prevalence per 100,000 individuals



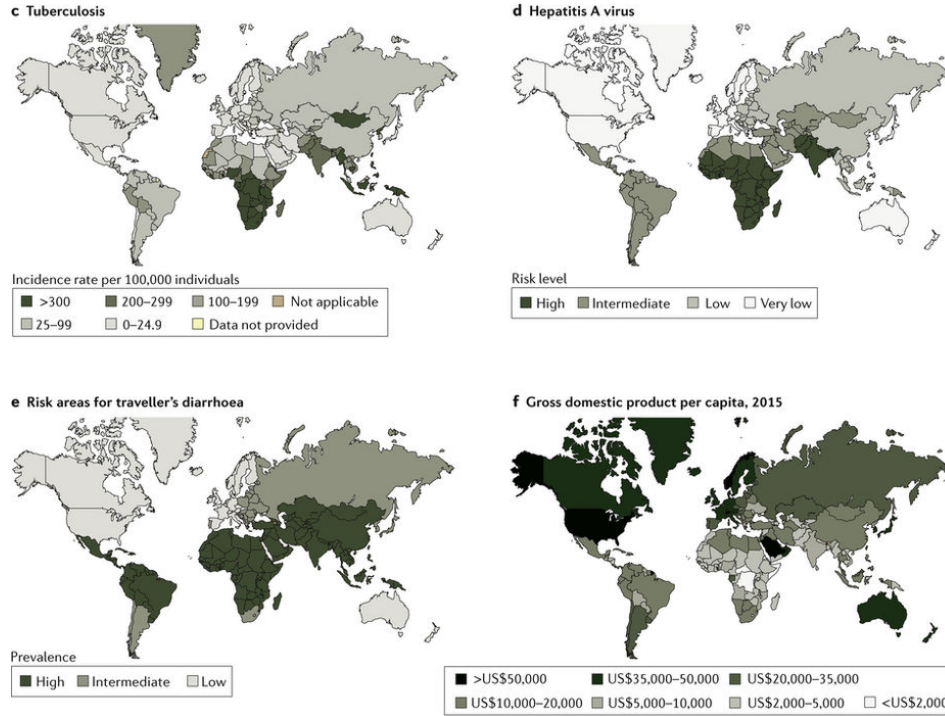
b Insulin-dependent diabetes (children 0–14 years)



Incidence rate per 100,000 children



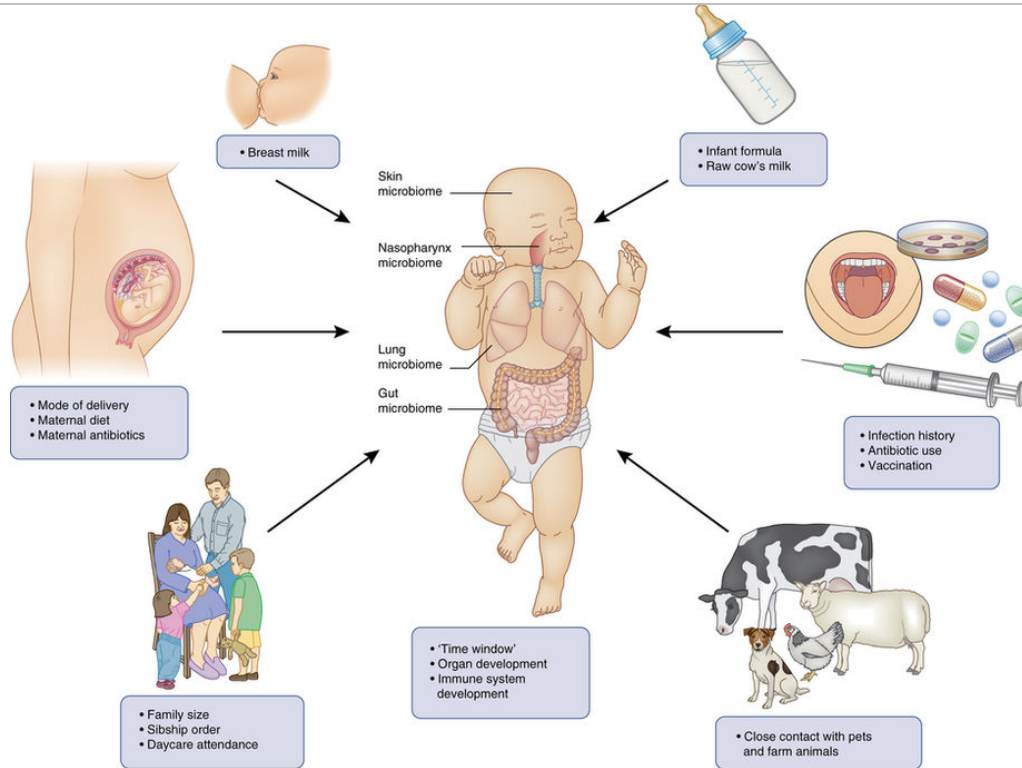
Infectious Disease Prevalence



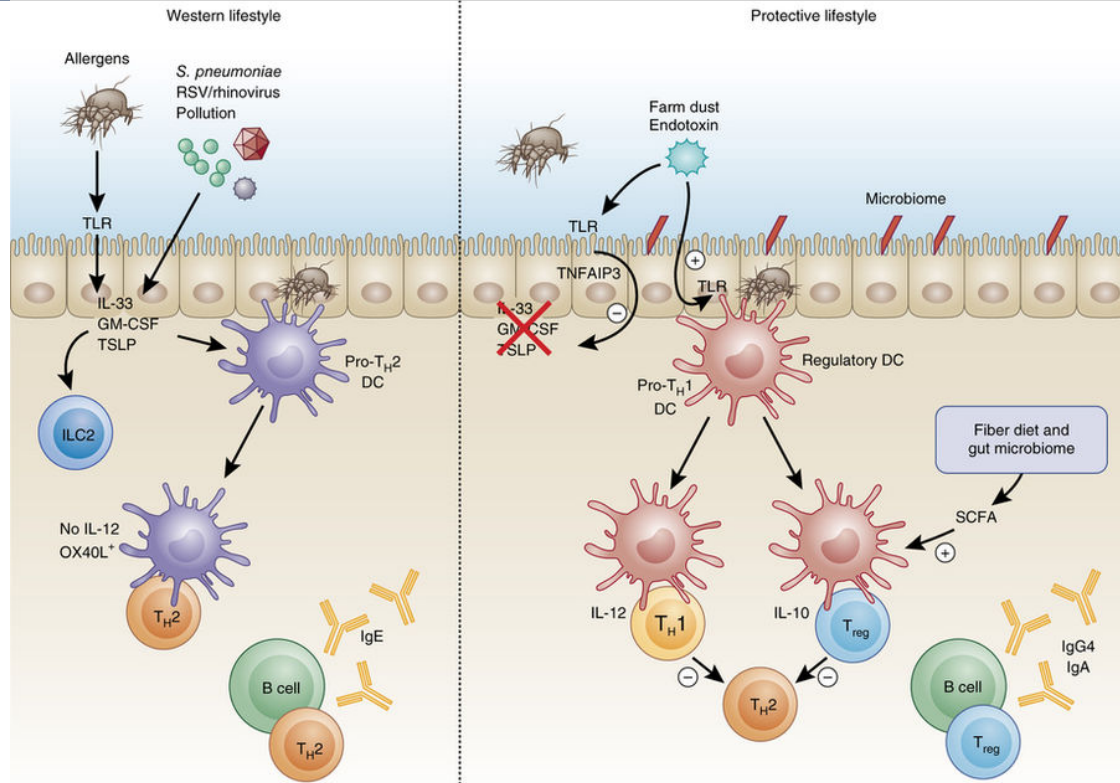
Nature Reviews | Immunology

Bach, Jean-François. "The hygiene hypothesis in autoimmunity: the role of pathogens and commensals." *Nature Reviews Immunology* (2017)

Hygiene Hypothesis



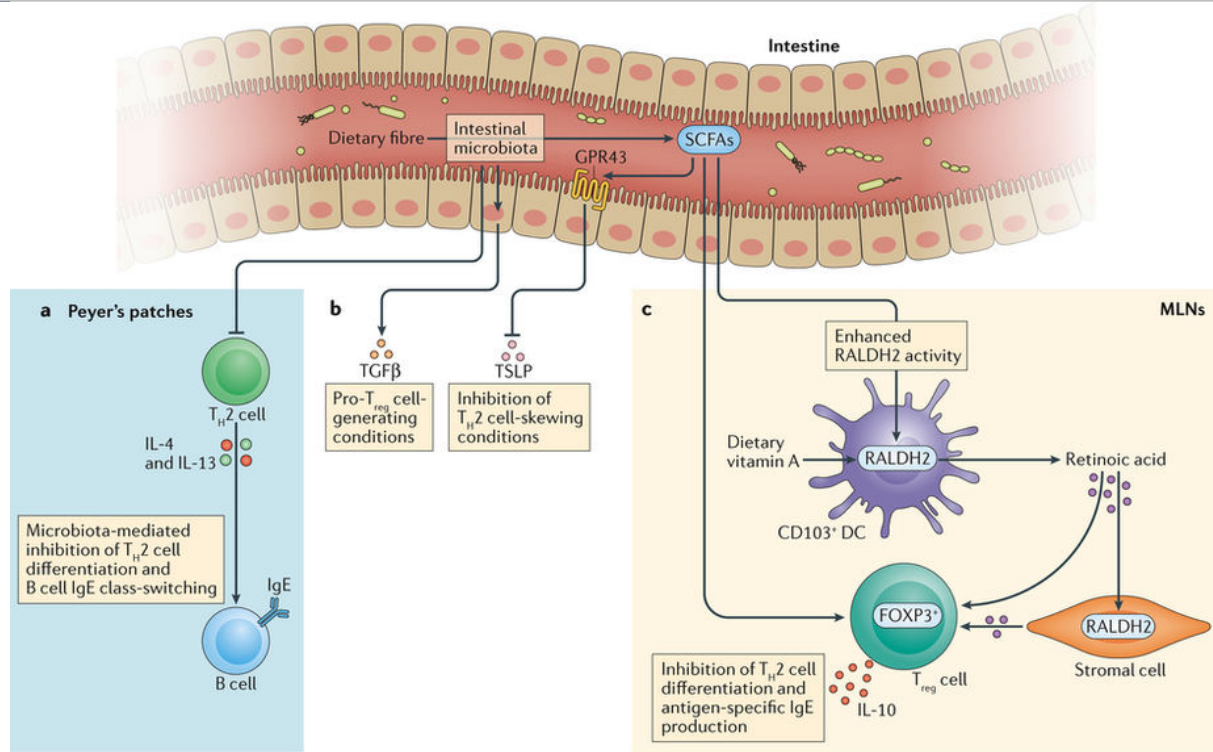
Cellular Mechanisms for the hygiene hypothesis



Debbie Maizels/Springer Nature

Lambrecht, Bart N., and Hamida Hammad. "The immunology of the allergy epidemic and the hygiene hypothesis." *Nature immunology* 18.10 (2017): 1076

Molecular Mechanisms for Hygiene Hypothesis



Combination of Factors Affecting Food Allergy

Tolerance

Low rates of infant eczema

- High ambient humidity
- Limited use of harsh detergents

High levels of vitamin D

- Increased ultraviolet light exposure
- Reduced sun avoidance

Dietary factors

- Boiled peanuts instead of roasted
- High intake of fruits and vegetables
- Non-westernized feeding patterns

High microbial exposure

- Large families, crowded living conditions
- Frequent and diverse exposure to animals (pets or livestock)
- Limited access to clean food and water
- High rates of *Helicobacter pylori* and parasitic infections
- Limited use of antibiotics in personal health and food chain
- Low rates of caesarian section delivery



Allergy

High rates of infantile eczema

- Frequent use of harsh detergents

Vitamin D insufficiency

- Sun avoidance
- Decreased ultraviolet light exposure

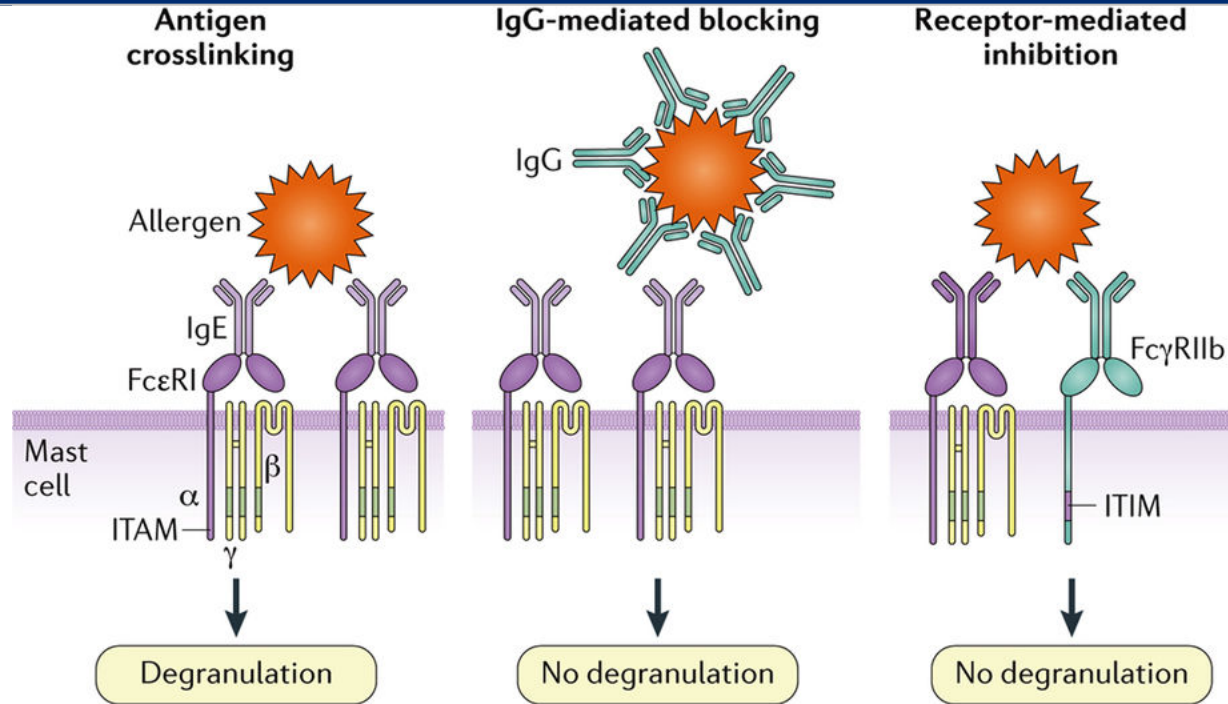
Dietary factors

- Westernized diet
- Westernized infant feeding patterns

Low microbial exposure

- Small families
- Limited exposure to animals
- Limited food diversity

One Example of Developed Immunological Tolerance





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