SAWA UNIVERSITY

المناعة 1

T Cell

جامعـــــــة ســـــــــاوة الاهلية — Sawa University

كليـــــة التقنيـــات الصحيـة والطبيـة — College of health and medical techniques

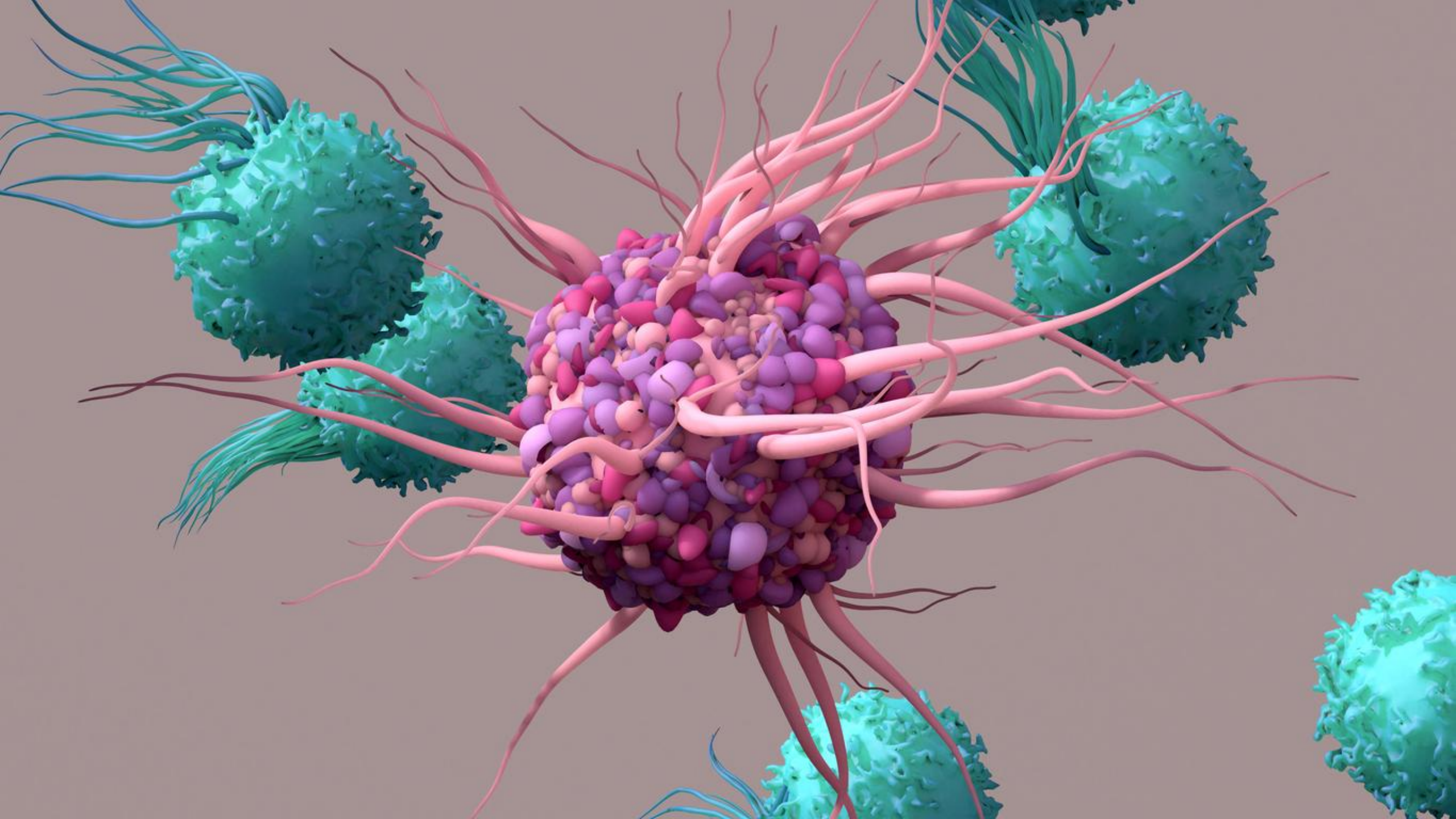
قسم تقنيات المختبرات الطبية — Department of Medical Laboratories

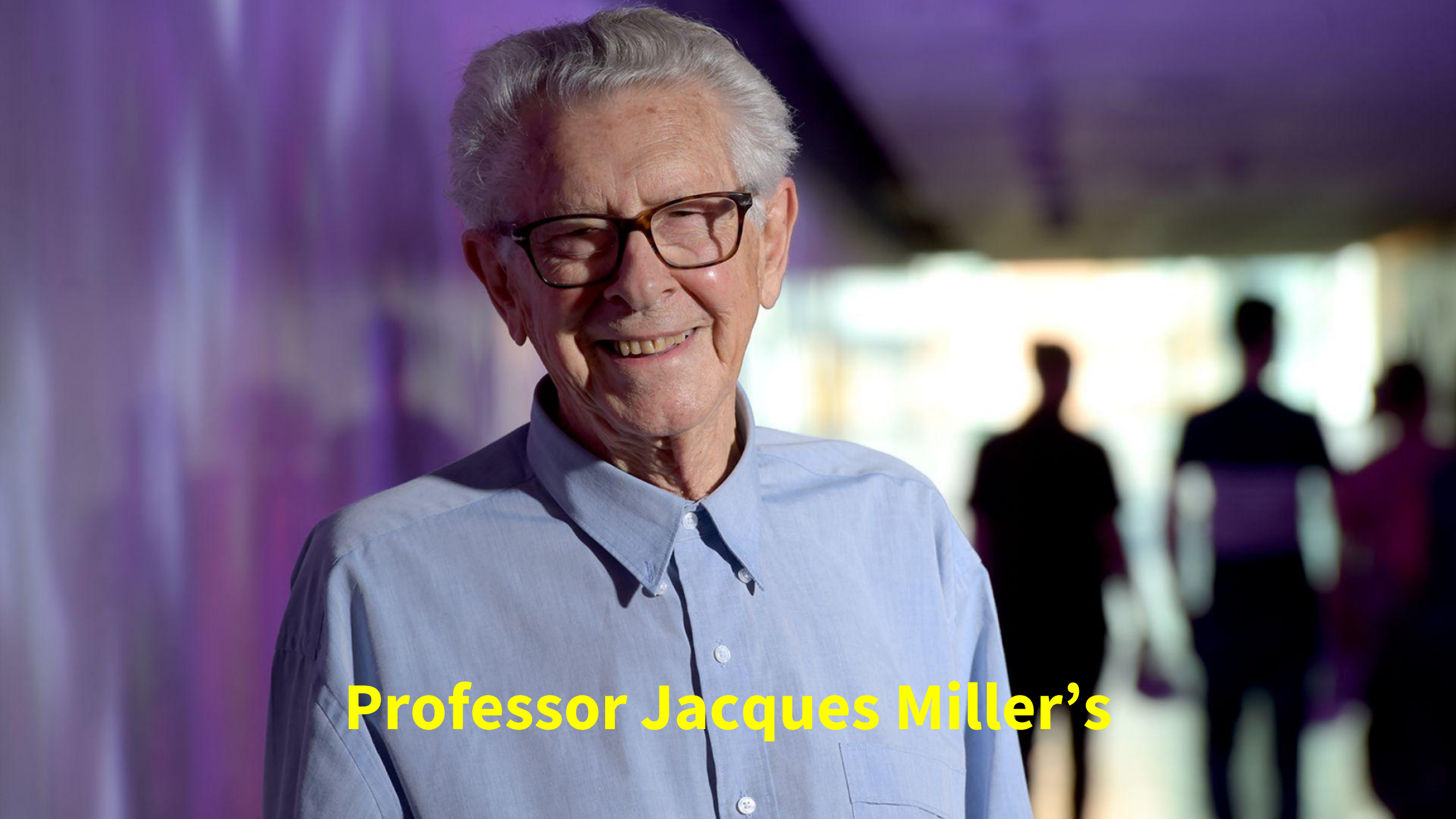
المرحلـــــــــــــة الثالثة — Third Stage

الجانب النظري — محاضرة رقم 8

Theoretical — Lecture No. 8

تدريسي المادة : د. زيدون حسين مهدي




Professor Jacques Miller’s

T Cells in Immunity

T cells are essential components of the **adaptive immune system** and play a central role in protecting the body against **infections** and **malignancies**. They originate from hematopoietic stem cells in the **bone marrow** but undergo maturation in the **thymus**, where they acquire their unique specificity through T-cell receptor (TCR) gene rearrangement.

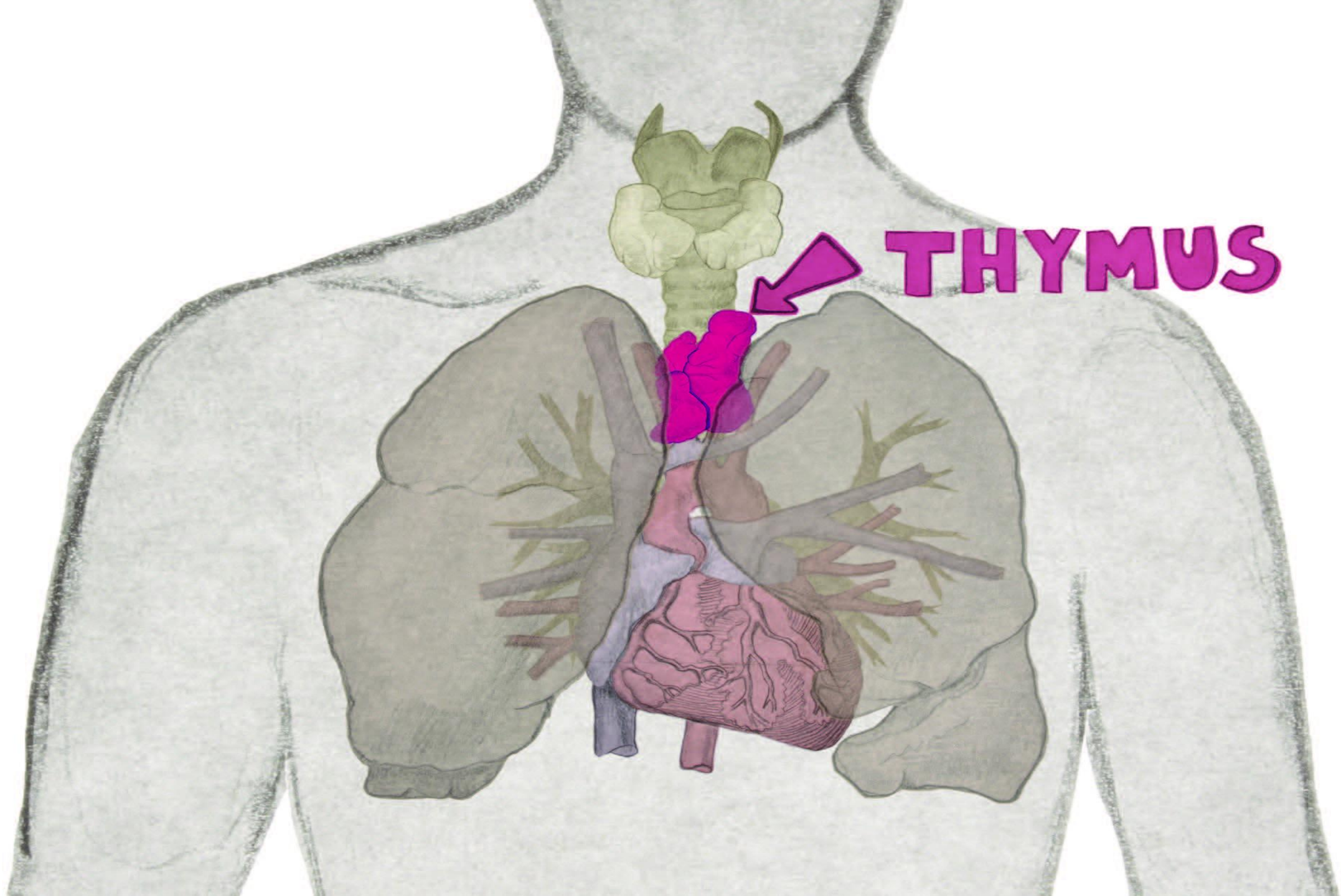
Unlike innate immune cells, T cells recognize antigens only when they are presented as peptide fragments bound to **major histocompatibility complex** (MHC) molecules on antigen-presenting cells.

Based on their surface markers and functions, T cells differentiate into several subsets, including **$CD4^+$ helper T cells**, **$CD8^+$ cytotoxic T cells**, and **regulatory T cells**. Each subset contributes uniquely to immunity: helper T cells orchestrate immune responses through cytokine secretion, cytotoxic T cells directly kill infected or abnormal cells, and regulatory T cells maintain immune tolerance.

Through their specificity, memory formation, and diverse effector functions, T cells are vital for long-term, antigen-specific immunity and are key targets for modern immunotherapies and vaccines.

T Cell Development: Bone Marrow to Thymus

- Precursors originate in the **bone marrow**
- Migration to the **thymus** for maturation
- TCR gene rearrangement occurs
- Development of CD4+ and CD8+ lineages


THYMUS

Thymic Selection

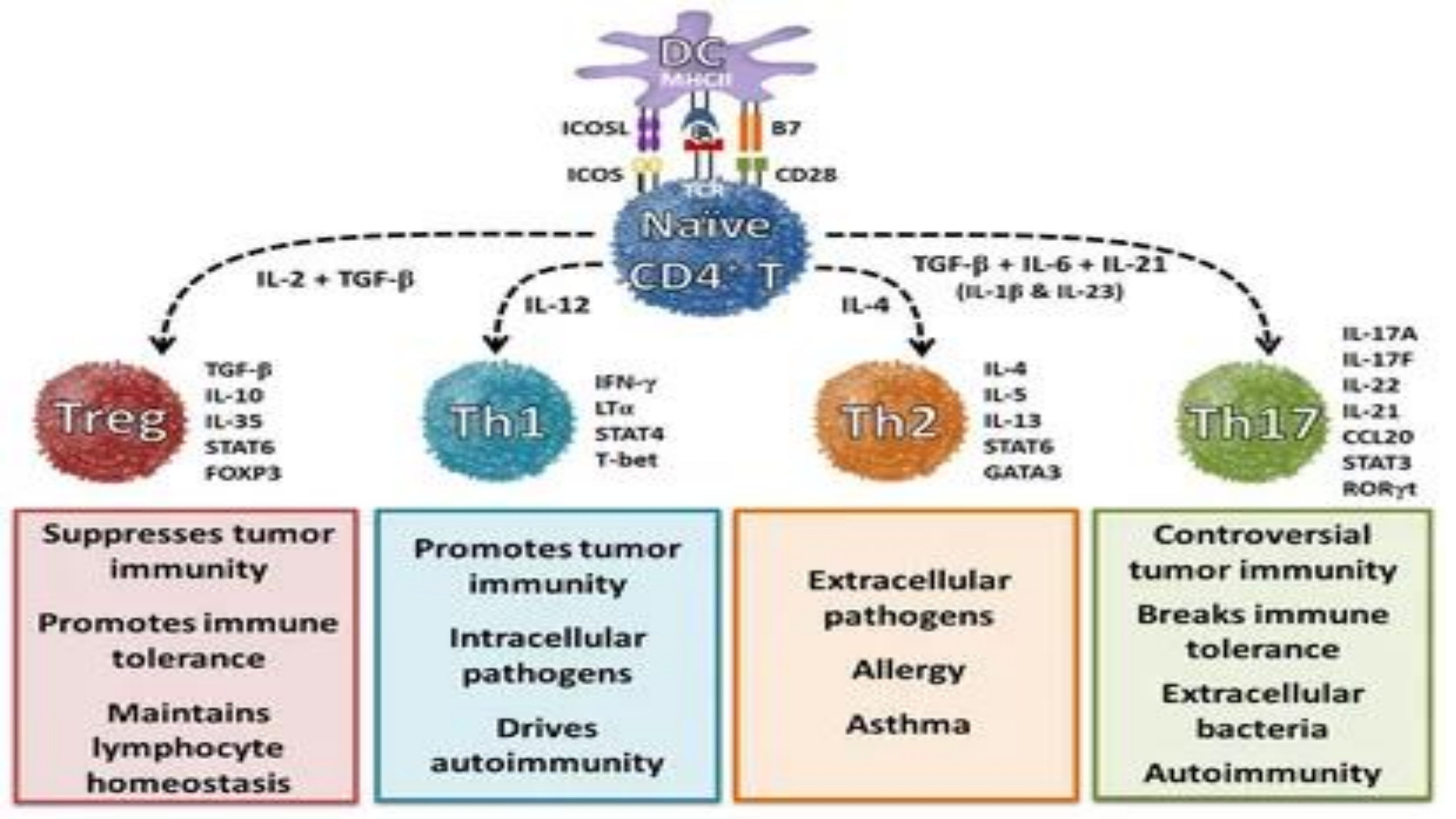
- **Positive selection**: ensures self-MHC recognition
- **Negative selection**: eliminates strongly self-reactive T cells
- Outcome: self-MHC restricted and self-tolerant T cells
- Failure leads to autoimmunity

CD4+ and CD8+ T Cell Subsets

- CD4+ T cells recognize MHC class II
- CD8+ T cells recognize MHC class I
- Functional specialization based on cytokine profiles
- Each subset plays a distinct immunological role

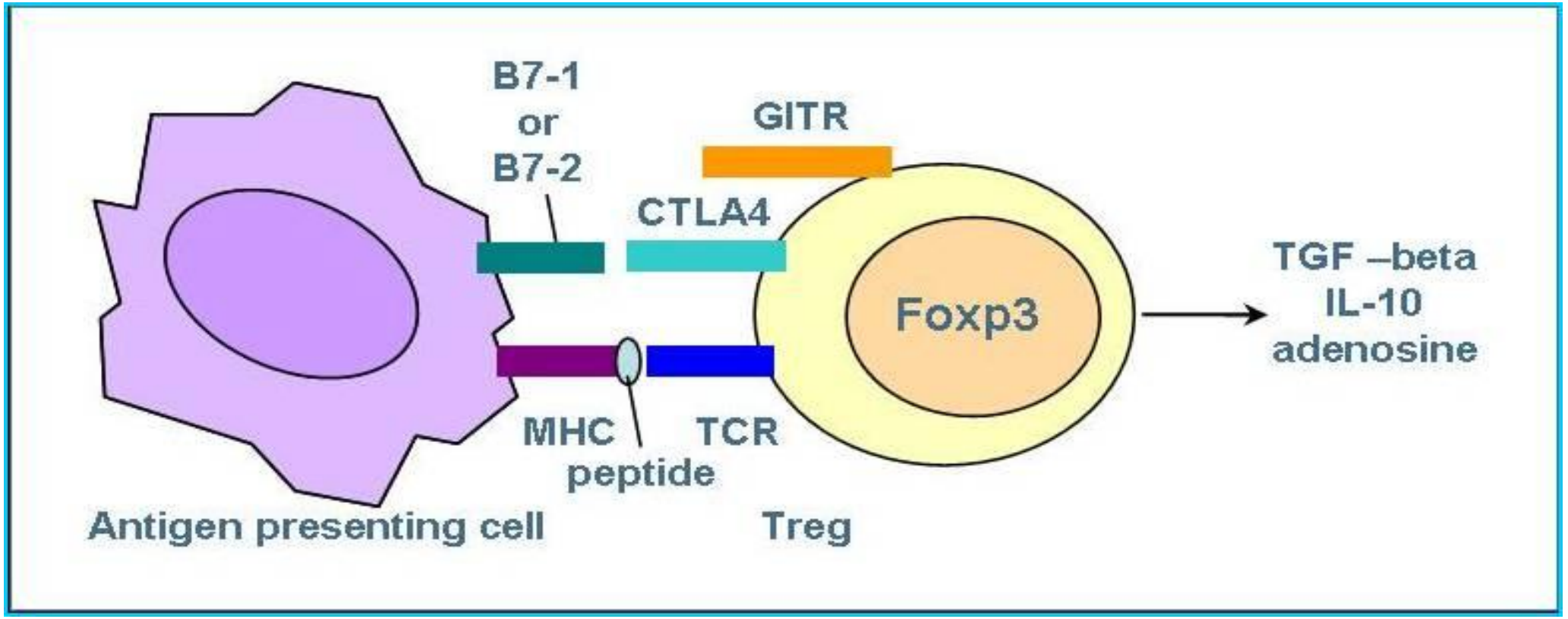
CD4+ Helper T Cell Differentiation

- Naive CD4+ cells differentiate based on cytokine environment
- Th1: IL-12-driven, promotes macrophage activation
- Th2: IL-4-driven, promotes IgE and eosinophils
- Th17: IL-6/TGF-β-driven, promotes neutrophils


DC
MHCII
ICOSL
B7
ICOS
TCR
CD28
Naïve
CD4+ T
IL-2 + TGF-β
IL-12
IL-4
TGF-β + IL-6 + IL-21
(IL-1β & IL-23)
Treg
TGF-β
IL-10
IL-35
STAT6
FOXP3
Th1
IFN-γ
LTα
STAT4
T-bet
Th2
IL-4
IL-5
IL-13
STAT6
GATA3
Th17
IL-17A
IL-17F
IL-22
IL-21
CCL20
STAT3
RORγt
Suppresses tumor immunity
Promotes immune tolerance
Maintains lymphocyte homeostasis
Promotes tumor immunity
Intracellular pathogens
Drives autoimmunity
Extracellular pathogens
Allergy
Asthma
Controversial tumor immunity
Breaks immune tolerance
Extracellular bacteria
Autoimmunity

Regulatory T Cells (Tregs)

- Characterized by **FoxP3** expression
- Maintains peripheral tolerance
- Suppresses autoreactive T cells
- Prevent chronic inflammation and autoimmune diseases



Tregs suppress activation, proliferation and cytokine production of CD4+ T cells and CD8+ T cells, and are thought to suppress B cells and dendritic cells. Tregs can produce soluble messengers which have a suppressive function, including **TGF-beta**, **IL-10** and **adenosine**.

Signals Required for T Cell Activation

- Signal 1: TCR recognition of peptide–MHC
- Signal 2: Co-stimulation such as CD28–B7
- Signal 3: Cytokines directing lineage commitment
- Absence of co-stimulation → anergy

Cytotoxic T Lymphocytes (CD8+)

- Recognize infected or tumor cells
- Use **perforin** and **granzymes** to induce apoptosis
- Secrete **IFN-γ** to enhance macrophage killing
- Central role in antiviral immunity

T Cells in Disease

- Infections: essential for viral clearance
- Autoimmune diseases: when tolerance fails
- Cancer: tumor-infiltrating T cells predict outcomes
- Transplantation: T cells mediate rejection


Thank you!