expression patterns, that is, they can express Th1-type cytokines or Th2-type cytokines. The following concerns T cells. T cells occur as two types, $CD4^+$ T cells and $CD8^+$ T cells, and once stimulated by a presented antigen, the T cells can undergo two consecutive responses, namely, naive immune response followed at a later time by memory immune response. Such an abundance of pairs is rarely found in any other field of science, except, perhaps, for physics. High school students are familiar with the wave/particle duality of light, with positive and negative electric fields, and with matter and anti-matter.

a. Myeloid DCs and plasmacytoid DCs

Dendritic cells occur as two types of cell lineages, myeloid dendritic cells, and plasmacytoid dendritic cells.

b. Th1-type response and Th2-type response

By expressing and releasing cytokines, dendritic cells can stimulate subsequent Th1-type immune response, or Th2-type immune response. For example, *Salmonella* bacteria can infect dendritic cells, and once inside, provoke the activation of the dendritic cells and stimulate the dendric cell to express IL-12 (80). Th1-type immune response involves increased expression of interleukin-12 (IL-12) and interferon-gamma (81).

To provide another example, certain allergens, and helminths such as *Schistosoma mansoni* (82) and *Nippostrongylus brasiliensis*, stimulate dendritic cells to express Th2-type cytokines (83,84). Th2-type immune response involves increasing the expression of the cytokines IL-5, IL-5, IL-9, and IL-13 (85). IL-12 is a master controller, as it stimulates Th1-type response and inhibits Th2-type response (86).

c. Externally acquired antigens and internally acquired antigens

Dendritic cells can present internally acquired antigens, that is, antigens newly biosynthesized in the dendritic cell, and these are presented by MHC class I (87,88). Dendritic cells can present externally acquired antigens, and these are presented by MHC class II.

[80] Brzoza KL, Rockel AB, Hiltbold EM. Cytoplasmic entry of Listeria monocytogenes enhances dendritic cell maturation and T cell differentiation and function. *J Immunol*. 2004;173:2641–2651.

[81] Lucey DR, Clerici M, Shearer GM. Type 1 and type 2 cytokine dysregulation in human infectious, neoplastic, and inflammatory diseases. *Clin Microbiol Rev*. 1996;9:532–562.

[82] de Jong EC, Vieira PL, Pawel Kalinski P, et al. Microbial compounds selectively induce Th1 cell-promoting or Th2 cell-promoting dendritic cells in vitro with diverse Th cell-polarizing signals. *J Immunol*. 2002;168:1704–1709.

[83] MacDonald AS, Maizels RM. Alarming dendritic cells for Th2 induction. *J Exp Med*. 2008;205:13–17.

[84] Ishiwata K, Watanabe N, Guo M, et al. Costimulator B7-DC attenuates strong Th2 responses induced by Nippostrongylus brasiliensis. *J Immunol*. 2010;184:2086–2094.

[85] Renauld JC. New insights into the role of cytokines in asthma. *J Clin Pathol*. 2001;54:577–589.

[86] Romani L, Puccetti P, Bistoni F. Interleukin-12 in infectious diseases. *Clin Microbiol Rev*. 1997;10:611–636.

[87] Qian SB, Reits E, Neefjes J, Deslich JM, Bennink JR, Yewdell JW. Tight linkage between translation and MHC class I peptide ligand generation implies specialized antigen processing for defective ribosomal products. *J Immunol*. 2006;177:227–233.

[88] Boes M, Stoppelenburg AJ, Sillé FC. Endosomal processing for antigen presentation mediated by CD1 and Class I major histocompatibility complex: roads to display or destruction. *Immunology*. 2009;127:163–170.