COVID-19:
Adapt, don't fight

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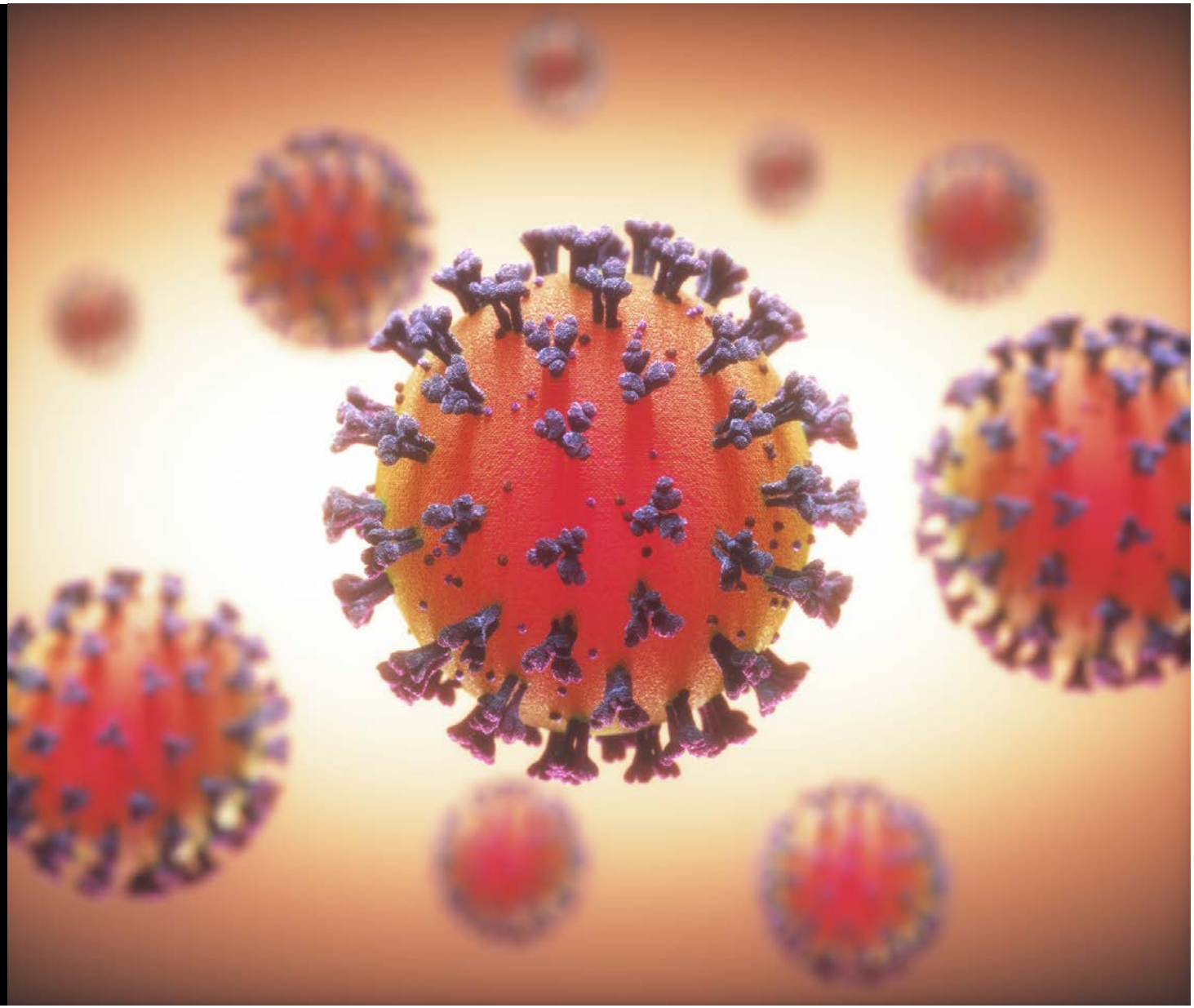
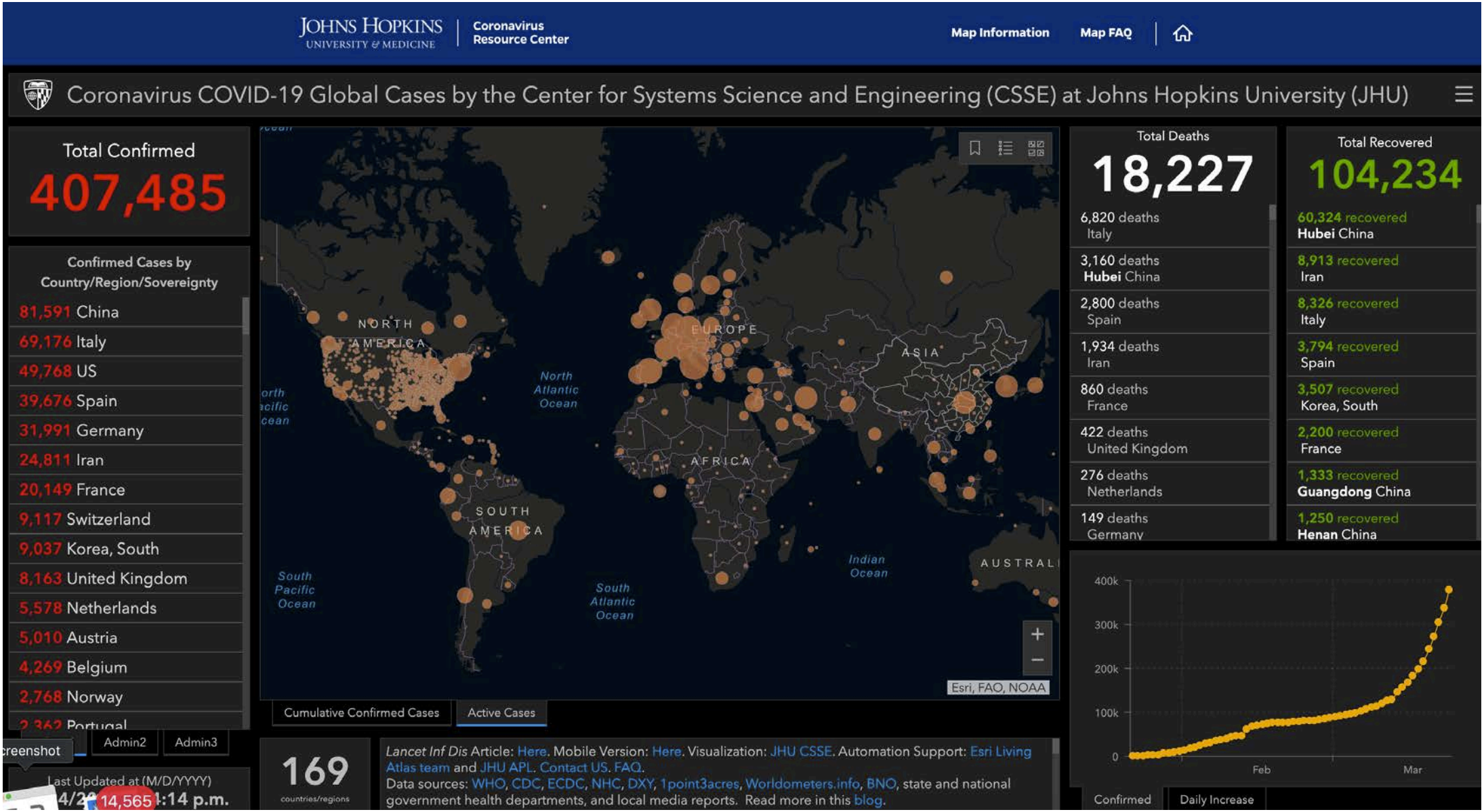



JOHNS HOPKINS UNIVERSITY & MEDICINE
Coronavirus Resource Center
Map Information
Map FAQ
Coronavirus COVID-19 Global Cases by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)
Total Confirmed
407,485
Confirmed Cases by Country/Region/Sovereignty
81,591 China
69,176 Italy
49,768 US
39,676 Spain
31,991 Germany
24,811 Iran
20,149 France
9,117 Switzerland
9,037 Korea, South
8,163 United Kingdom
5,578 Netherlands
5,010 Austria
4,269 Belgium
2,768 Norway
Admin2
Admin3
Last Updated at (M/D/YYYY)
14,565 4:14 p.m.
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
North Atlantic Ocean
South Pacific Ocean
South Atlantic Ocean
Indian Ocean
Esri, FAO, NOAA
Cumulative Confirmed Cases
Active Cases
169
countries/regions
Lancet Inf Dis Article: Here. Mobile Version: Here. Visualization: JHU CSSE. Automation Support: Esri Living Atlas team and JHU APL. Contact US. FAQ.
Data sources: WHO, CDC, ECDC, NHC, DXY, 1point3acres, Worldometers.info, BNO, state and national government health departments, and local media reports. Read more in this blog.
Total Deaths
18,227
6,820 deaths Italy
3,160 deaths Hubei China
2,800 deaths Spain
1,934 deaths Iran
860 deaths France
422 deaths United Kingdom
276 deaths Netherlands
149 deaths Germany
Total Recovered
104,234
60,324 recovered Hubei China
8,913 recovered Iran
8,326 recovered Italy
3,794 recovered Spain
3,507 recovered Korea, South
2,200 recovered France
1,333 recovered Guangdong China
1,250 recovered Henan China
400k
300k
200k
100k
0
Feb
Mar
Confirmed
Daily Increase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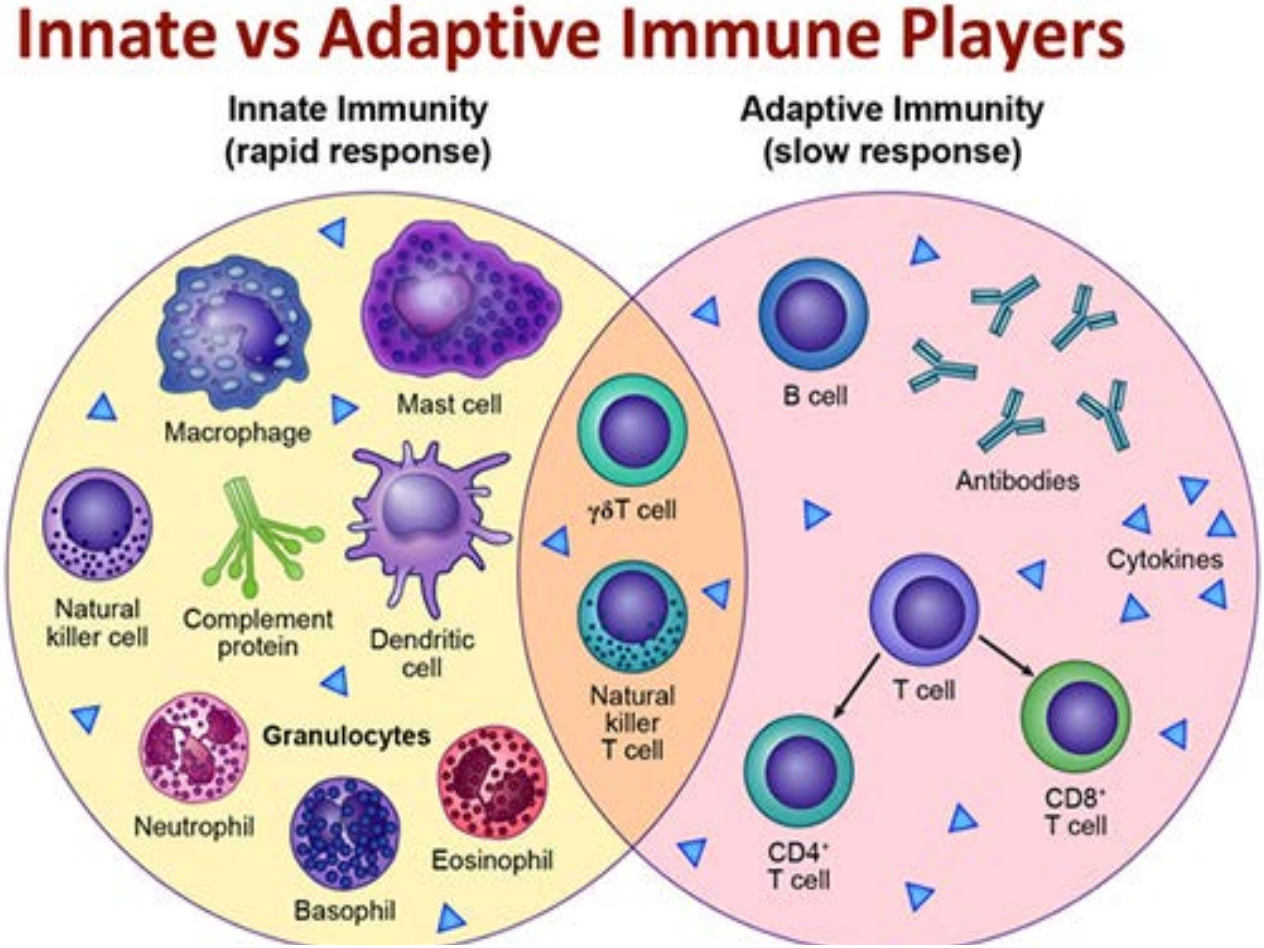
Immune system 101



Dranoff G. *Nat Rev Cancer*. 2004; 4: 11-22.

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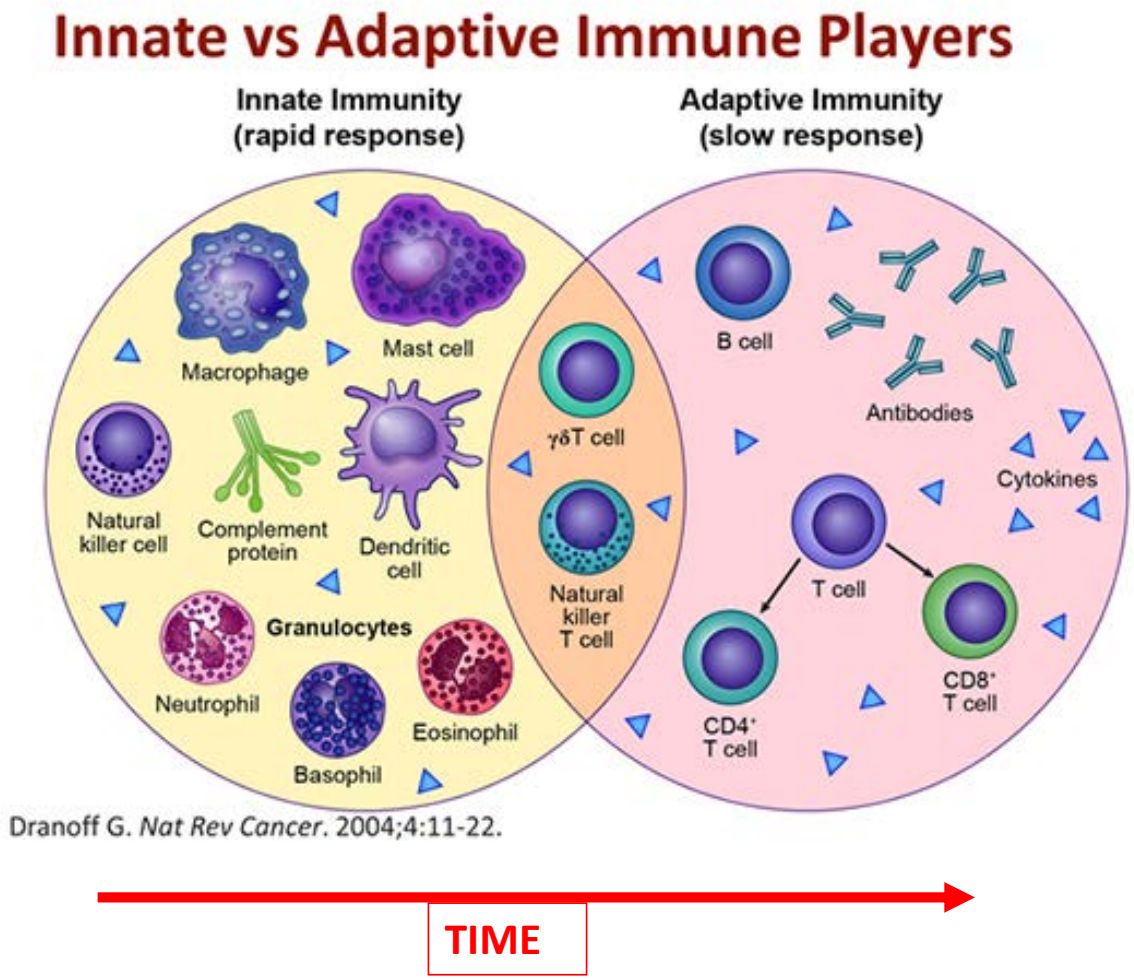
Our innate evolutionary protection

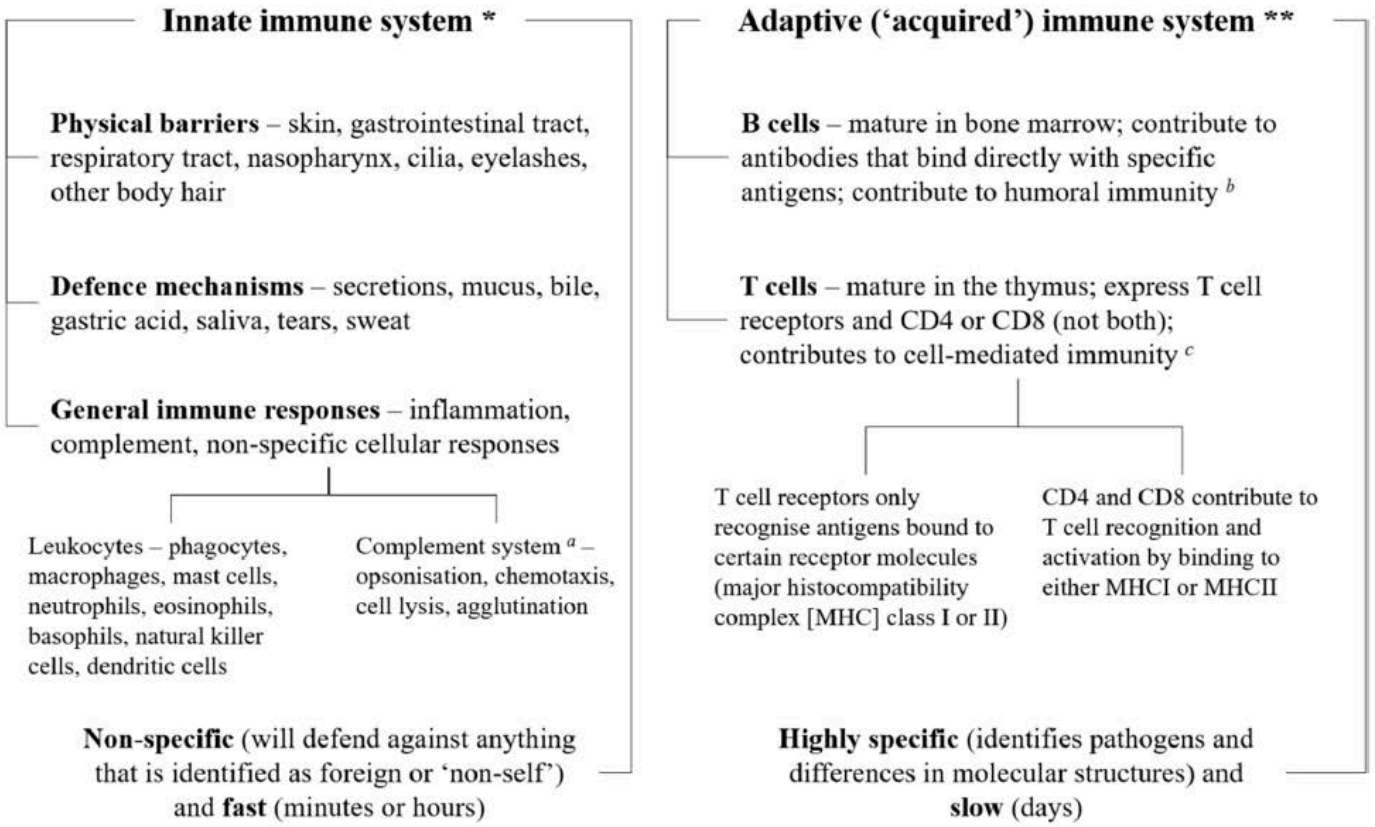
The immune system



Innate – defence against invaders (bacteria, viruses, pathogens)

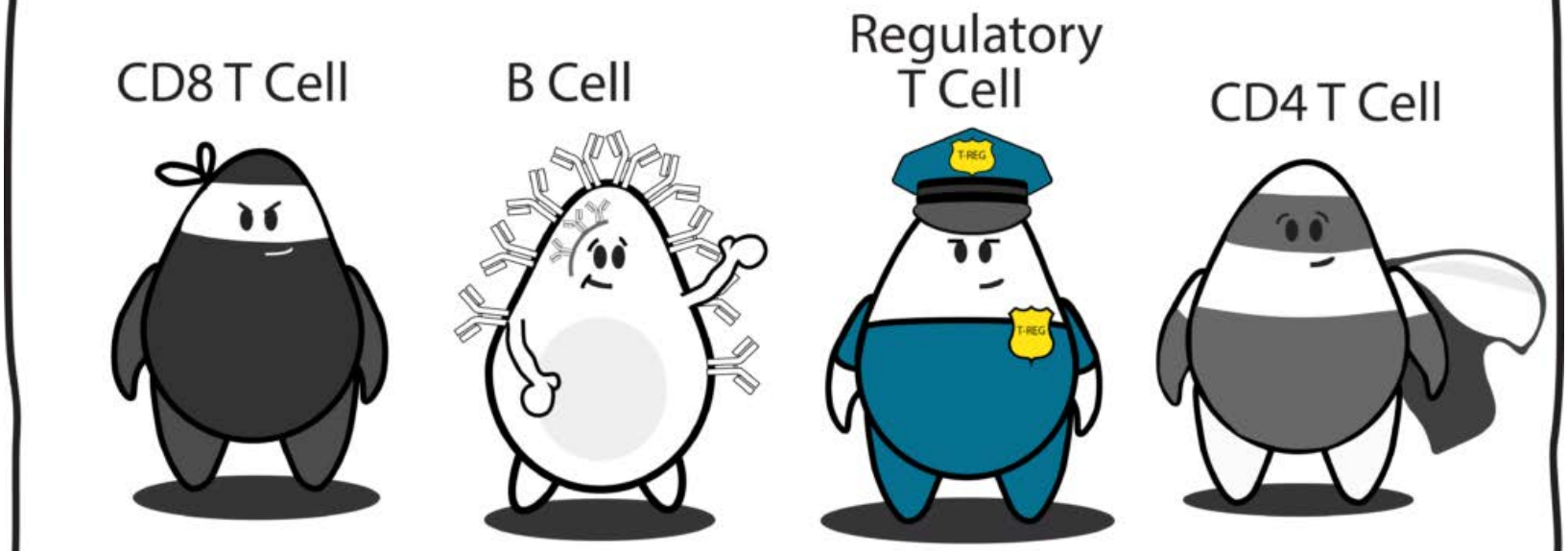
Adaptive – distinguishes self from non-self, learns over time, must become 'tolerant'

Proper immune function is based on the balance and tolerance between the innate and adaptive immune systems

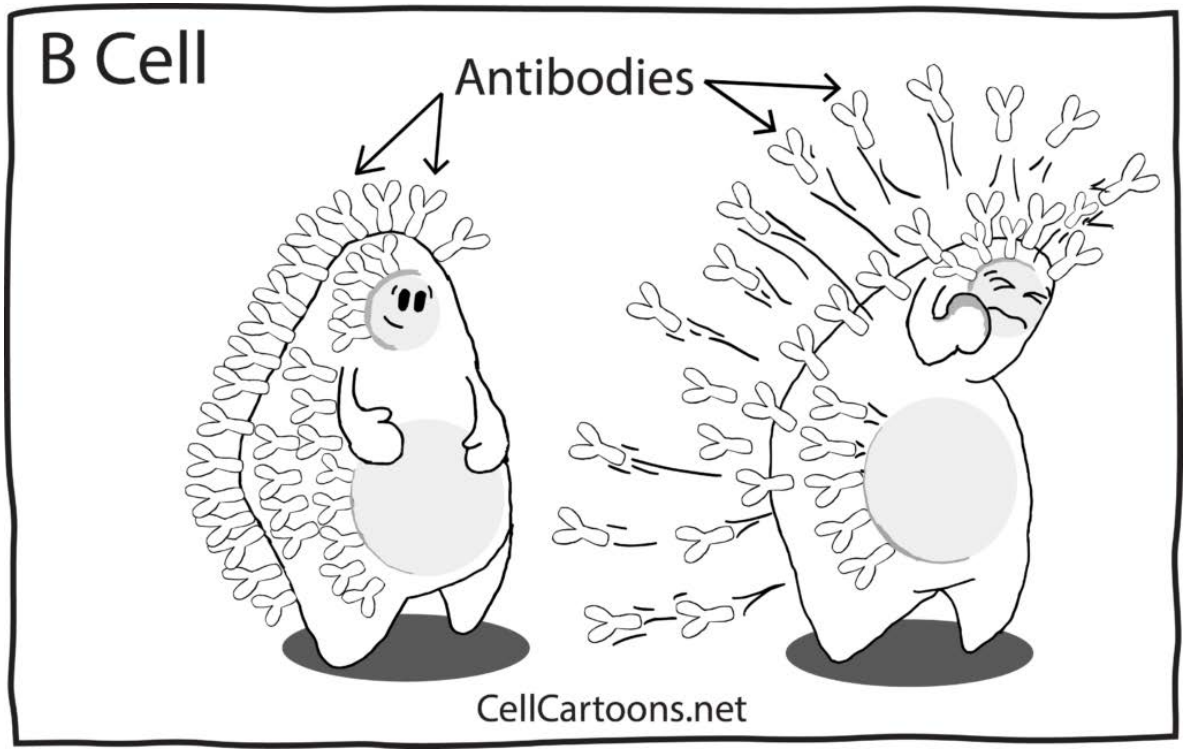


Maggini et al. *Nutrients*. 2018; 10(10). pii: E1531.

Lymphocytes



CellCartoons.net



5 classes of antibodies

IgM – largest and first to appear on the scene after exposure

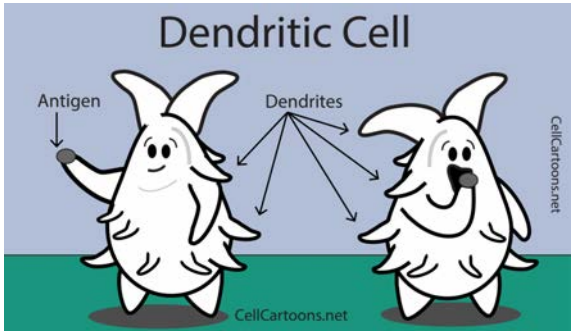
IgE – allergies, anaphylactic shock

IgG – ¾ of AB in blood, involved in food sensitivity & intolerance

IgA – high numbers in gut mucosa

IgD – a bit of a stealth fighter, important, but secret!

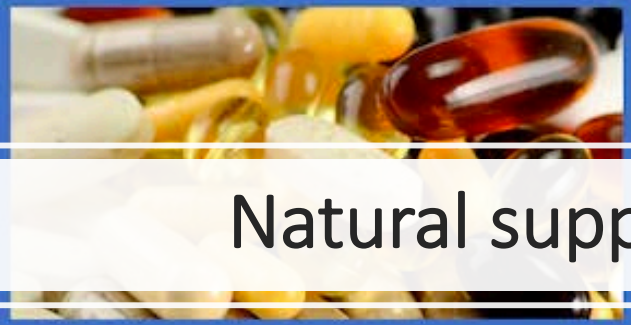
T cells

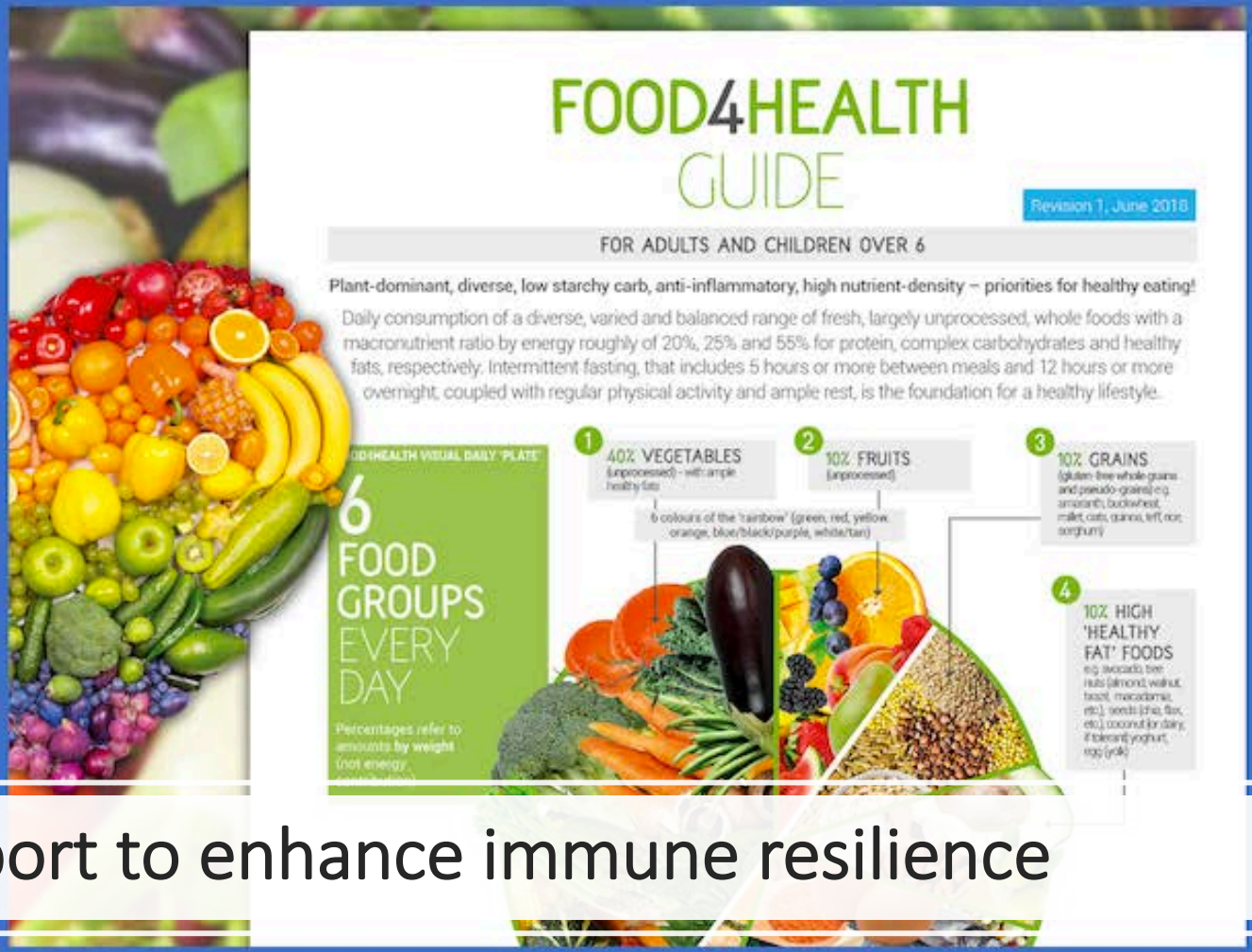


- Very similar to B cells, made in the thymus, about 1 trillion in the body
- Antibodies (B cells), made in the bone marrow, marks the invader (antigen) and the T cells come in for the 'kill'
- Specific T cells for specific antigens (learns over time / adaptive)
- T cells make many clones to deal with the invader – sickness time
- Once vanquished, you've built up immunity

BUT:

- The whole system only works if the invaders are presented to the T cells correctly (dendritic cells and MHC class I & II)
- And if the T cells then recognise the invader and **act appropriately**





Natural support to enhance immune resilience

FOOD IS MEDICINE – Always food first!

www.anhinternational.org – Search Food for Health campaign

nutrients

MDPI

Review

Immune Function and Micronutrient Requirements Change over the Life Course

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Abstract: As humans age, the risk and severity of infections vary in line with immune competence according to how the immune system develops, matures, and declines. Several factors influence the immune system and its competence, including nutrition. A bidirectional relationship among nutrition, infection and immunity exists: changes in one component affect the others. For example, distinct immune features present during each life stage may affect the type, prevalence, and severity of infections, while poor nutrition can compromise immune function and increase infection risk. Various micronutrients are essential for immunocompetence, particularly vitamins A, C, D, E, B2, B6, and B12, folic acid, iron, selenium, and zinc. Micronutrient deficiencies are a recognized global public health issue, and poor nutritional status predisposes to certain infections. Immune function may be improved by restoring deficient micronutrients to recommended levels, thereby increasing resistance to infection and supporting faster recovery when infected. Diet alone may be insufficient and tailored micronutrient supplementation based on specific age-related needs necessary. This review looks at immune considerations specific to each life stage, the consequent risk of infection, micronutrient requirements and deficiencies exhibited over the life course, and the available evidence regarding the effects of micronutrient supplementation on immune function and infection.

Keywords: adults; age-related immunity; deficiency; elderly; immunosenescence; infants; infection; micronutrients; older people

Personalised, gender, time-specific, individual-specific

- What is the need?
- What is the intake?
- What is the absorption?
- Is the nutrient form optimal?

Maggini et al. *Nutrients*. 2018; 10(10). pii: E1531.

Table 1. Overview of key roles played by select micronutrients in the immune system [4,9–14].

Micronutrient/Role	Innate Immunity	Adaptive Immunity
Vitamin C	Effective antioxidant that protects against ROS and RNS produced when pathogens are killed by immune cells [9,14] Regenerates other important antioxidants such as glutathione and vitamin E to their active state [9] Promotes collagen synthesis, thereby supporting the integrity of epithelial barriers [10] Stimulates production, function and movement of leukocytes (e.g., neutrophils, lymphocytes, phagocytes) [9,14] Increases serum levels of complement proteins [14] Has roles in antimicrobial and NK cell activities and chemotaxis [10] Involved in apoptosis and clearance of spent neutrophils from sites of infection by macrophages [12]	Can increase serum levels of antibodies [12,14] Has roles in lymphocyte differentiation and proliferation [10,12]
Vitamin D	Vitamin D receptor expressed in innate immune cells (e.g., monocytes, macrophages, dendritic cells) [14] Increases the differentiation of monocytes to macrophages [10] Stimulates immune cell proliferation and cytokine production and helps protect against infection caused by pathogens [14] 1,25-dihydroxyvitamin D_3, the active form of vitamin D, regulates the antimicrobial proteins cathelicidin and defensin, which can directly kill pathogens, especially bacteria [14]	Mainly inhibitory effect in adaptive immunity [14]; for example, 1,25-dihydroxyvitamin D_3 suppresses antibody production by B cells and inhibits T cell proliferation [14]
Vitamin A	Helps maintain structural and functional integrity of mucosal cells in innate barriers (e.g., skin, respiratory tract, etc.) [14] Important for normal functioning of innate immune cells (e.g., NK cells, macrophages, neutrophils) [14]	Necessary for proper functioning of T and B lymphocytes, and thus for generation of antibody responses to antigen [14] Involved in development and differentiation of Th1 and Th2 cells and supports Th2 anti-inflammatory response [10]
Vitamin E	An important fat-soluble antioxidant [10] Protects the integrity of cell membranes from damage caused by free radicals [14] Enhances IL-2 production and NK cell cytotoxic activity [10]	Enhances T cell-mediated functions and lymphocyte proliferation [10] Optimizes and enhances Th1 and suppresses Th2 response [10]
Vitamin B6	Helps regulate inflammation [13] Has roles in cytokine production and NK cell activity [13,15]	Required in the endogenous synthesis and metabolism of amino acids, the building blocks of cytokines and antibodies [14] Has roles in lymphocyte proliferation, differentiation and maturation [14] Maintains Th1 immune response [10] Has roles in antibody production [13]

Maggini et al. *Nutrients*. 2018; 10(10). pii: E1531.

Table 1. *Cont.*

Micronutrient/Role	Innate Immunity	Adaptive Immunity
Vitamin B12	Has roles in NK cell functions [13]	May act as an immunomodulator for cellular immunity, especially with effects on cytotoxic cells (NK cells, $CD8^+$ T-cells) [10] Facilitates production of T lymphocytes [13] Involved in humoral and cellular immunity and one-carbon metabolism (interactions with folate) [13]
Folate	Maintains innate immunity (NK cells) [10]	Has roles in cell-mediated immunity [13] Important for sufficient antibody response to antigens [13] Supports Th 1-mediated immune response [13]
Zinc	Antioxidant effects protect against ROS and RNS [9] Helps modulate cytokine release and induces proliferation of $CD8^+$ T cells [10,16] Helps maintain skin and mucosal membrane integrity [10]	Central role in cellular growth and differentiation of immune cells that have a rapid differentiation and turnover [17] Essential for intracellular binding of tyrosine kinase to T cell receptors, required for T lymphocyte development and activation [9] Supports Th1 response [10]
Iron	Involved in regulation of cytokine production and action [10] Forms highly-toxic hydroxyl radicals, thus involved in the process of killing bacteria by neutrophils [10] Important in the generation of ROS that kill pathogens [14]	Important in the differentiation and proliferation of T lymphocytes [14] Essential for cell differentiation and growth, component of enzymes critical for functioning of immune cells (e.g., ribonucleotide reductase involved in DNA synthesis) [10]
Copper	Free-radical scavenger [4] Antimicrobial properties [14] Accumulates at sites of inflammation, important for IL-2 production and response [13,14] May play a role in the innate immune response to bacterial infections [14]	Has roles in T cell proliferation [13] Has roles in antibody production and cellular immunity [18]
Selenium	Essential for the function of selenium-dependent enzymes (selenoproteins) that can act as redox regulators and cellular antioxidants, potentially counteracting ROS [10,14] Selenoproteins are important for the antioxidant host defense system affecting leukocyte and NK cell function [13]	Involved in T lymphocyte proliferation [4,13] Has roles in the humoral system (e.g., immunoglobulin production) [13]

IL, interleukin; NK, natural killer; RNS, reactive nitrogen species; ROS, reactive oxygen species; Th, helper T cell.

Maggini et al. *Nutrients*. 2018; 10(10). pii: E1531.

Immune resilience - naturally

From the kitchen…

- Bone broth (organic bones preferable)
- Mushrooms for their beta-glucans
- Garlic (use liberally!)
- Turmeric (curcumin) root (freeze and grate when needed, use in cooking and drink as tea)
- Fresh herbs, especially oregano, rosemary and thyme
- Manuka honey (1 tsp a day, don’t heat over 40 degrees)

Immune resilience - naturally

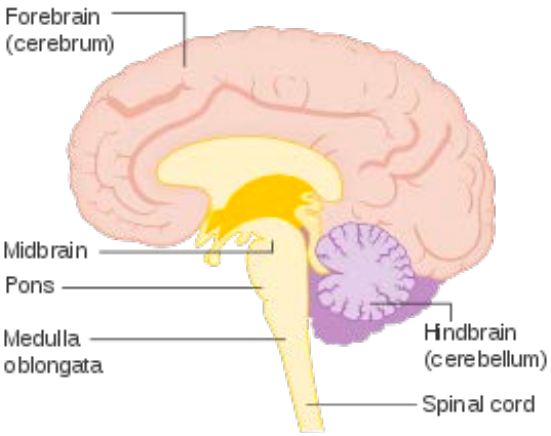
From the supplement cupboard…

- ZINC: stimulates the thymus to produce new T cells - coordinates entire adaptive immune system response. 25 - 50 mg per day can help to modulate cytokine activity, stimulate the activity of natural T killer cells and T-cell precursors.
- VITAMIN A (retinyl palmitate): supports normal function of both innate and adaptive immune response. Liver (organic), cheese, fish and eggs. 800 - 12,500 mcg retinol equivalents.
- VITAMIN C: Critical for immune modulation and we can't make it in our bodies. 250 - 500 mg per day, but up to 2-3g and higher may be used short term when immune challenged.
- VITAMIN D: One of the earliest substances in our evolution, essential for health of every cell. Intimately involved with immune function, need adequate Mg for function. 4,000 - 5,000 IU a day
- NUCLEOTIDES: Building blocks of DNA, necessary for proper immune function and needed in vast quantities when the immune system is upregulated. Good sources are organ meats and offal, but too little in other foods. Taking as a powdered supplement is useful.

AND: Sleep! Prioritise 6-9 hours of good quality sleep every night.

FOR MORE INFORMATION AND ADDITIONAL NUTRIENTS
https://www.anhinternational.org/news/build-your-immune-resilience-as-nature-intended

DID YOU KNOW YOU HAVE 3 BRAINS?

ANATOMY	NAMES		FUNCTIONS
	FOREBRAIN`	‘HUMAN BRAIN’	Reasoning, skills, problem-solving, Regulates autonomic, endocrine, motor functions
	MIDBRAIN	‘MONKEY BRAIN’	Regulates movement, processing of auditory and visual information
	HINDBRAIN	‘LIZARD BRAIN’	Housekeeping functions, autonomic nervous system, movement coordination, balance

Increasingly higher functions

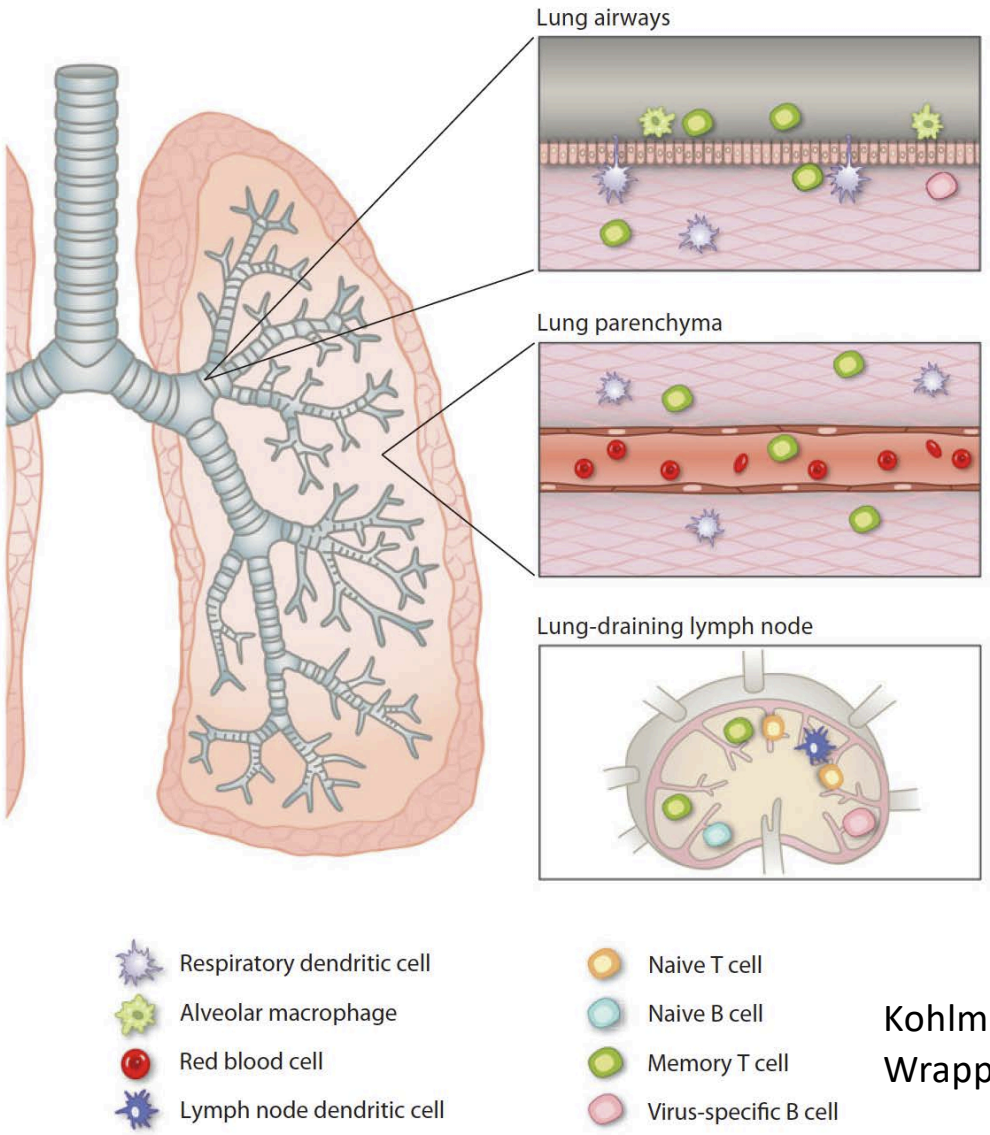
Fear takes you into your lizard brain and derails your ability to make good decisions.
Fear is bad for immune resilience.

Strategies to move out of fear

- Try to limit yourself to one session of media per day during this time. The media reports can be heavily negative, loading your subconscious with fear
- Use breathing and mindfulness techniques through the day to reconnect to yourself (choose from the many online)
- Get out in nature (for your one session of exercise!) every day, connect to the ground and the environment around you
- Intersperse your day with 1-3 mins of appreciation time for the things in your life you're grateful for
- Keep active, keep moving and avoid comfort eating
- Remember that humans have always lived with uncertainty and we're built for it, both psychologically and physically.

Immune function and the respiratory system

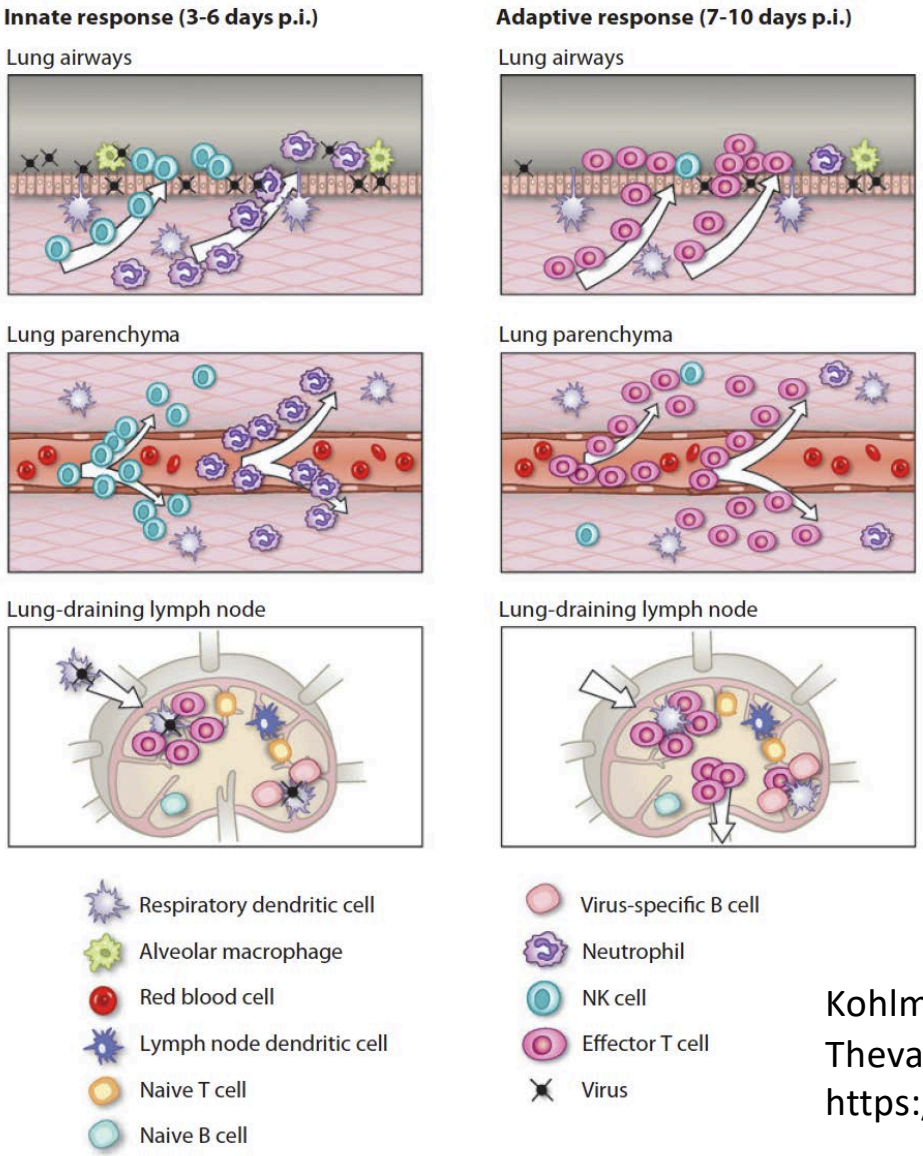
RESPIRATORY VIRUSES AND THE IMMUNE SYSTEM



- Note: SARS-COV-2 targets ACE2 binding sites in alveoli

Kohlmeier & Woodland. *Annu. Rev. Immunol.* 2009; 27: 61-82.
Wrapp et al. *Science* 2020; 367 (6483): 1260-1263.

RESPIRATORY VIRUSES AND THE IMMUNE SYSTEM



- Respiratory dendritic cells (of the innate immune system) critical in marking virus and virus-infected cells for effector T cells
- For SARS-CoV-2 key adaptive immune response mediated by T_{FH} and cytotoxic CD8+ cells

Kohlmeier & Woodland. *Annu. Rev. Immunol.* 2009; 27: 61-82.
Thevarajan et al. *Nature Medicine* 2020; https://doi.org/10.1038/s41591-020-0819-2.

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