

The Effect of Diet on Inflammation

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We recruit volunteers...



...feed them experimental diets...



...analyze what they eat...



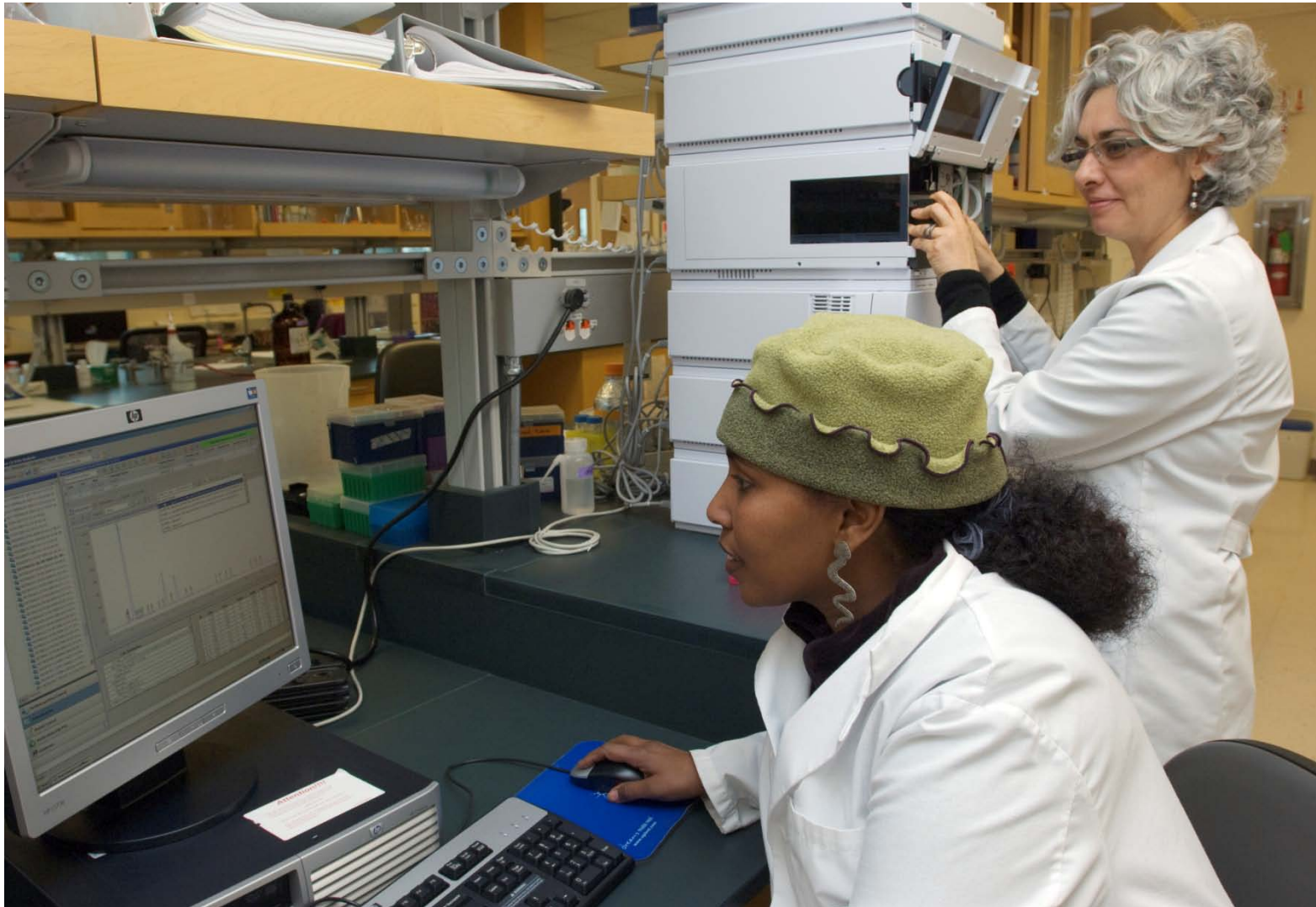
...measure how it affects fitness...



...or bone density...



...or inflammation!



What is (Acute) Inflammation?

Rubor (redness)

Dolor (pain)

Calor (heat)

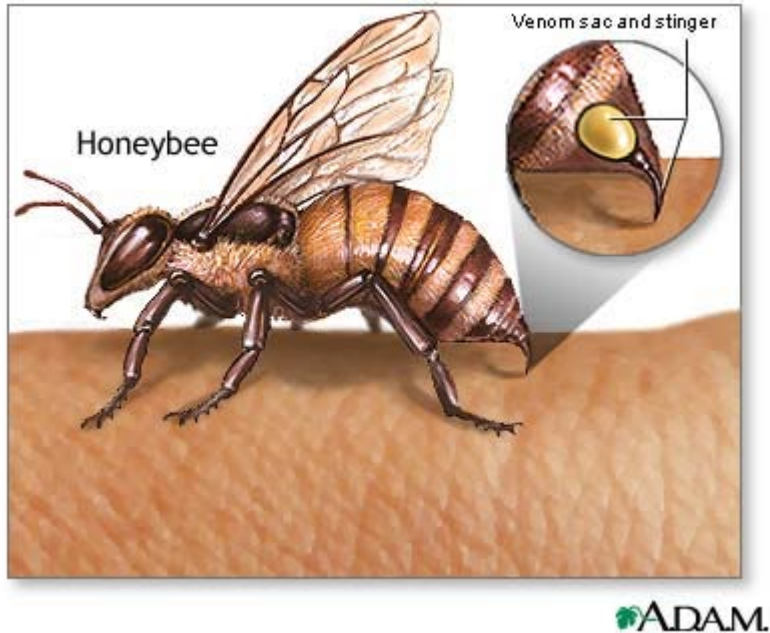
Tumor (swelling)



Aulus Cornelius Celsus

25 BC – 50 AD

Allergic (and toxic) Inflammation



Redness, Pain,
Heat, Swelling

Vaccine Site Inflammation



Inflammation Involves 4 Steps

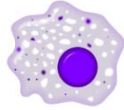
1. Infection or tissue damage



Inflammation Involves 4 Steps

2. Activation of local cells, including

- Macrophages



- Dendritic cells

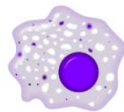


Inflammation Involves 4 Steps

3. Call 911 and the police arrive.

Activated cells send signals to attract white blood cells and allow them to enter tissues.

- Macrophage



multi-purpose; kill bacteria & viruses, clean up damaged tissue; chronic inflammation

- Neutrophil



kill bacteria; acute inflammation

- Lymphocyte

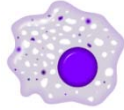


chronic inflammation; vaccine memory

Inflammation Involves 4 Steps

4. Resolution (back to normal)

- Macrophages



- Dendritic cells



Acute inflammation resolves quickly.

Chronic inflammation does not.

What is chronic Inflammation?

Heart Disease

Cancer

Alzheimer's

Allergies

Asthma

Intestinal
inflammation

etc...



2004

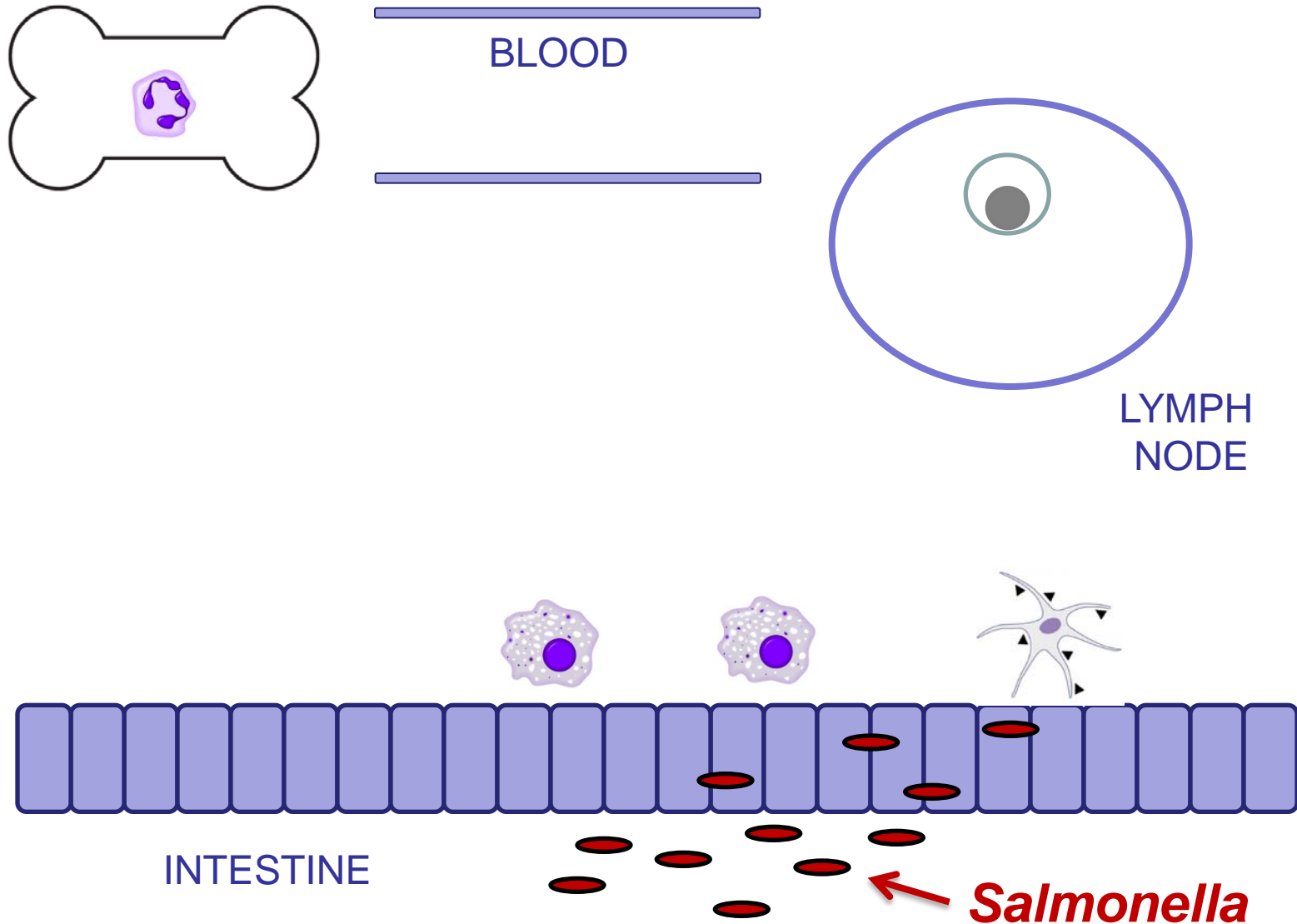
Examples of How Diet Can Minimize Inflammation

Probiotics and Intestinal Inflammation

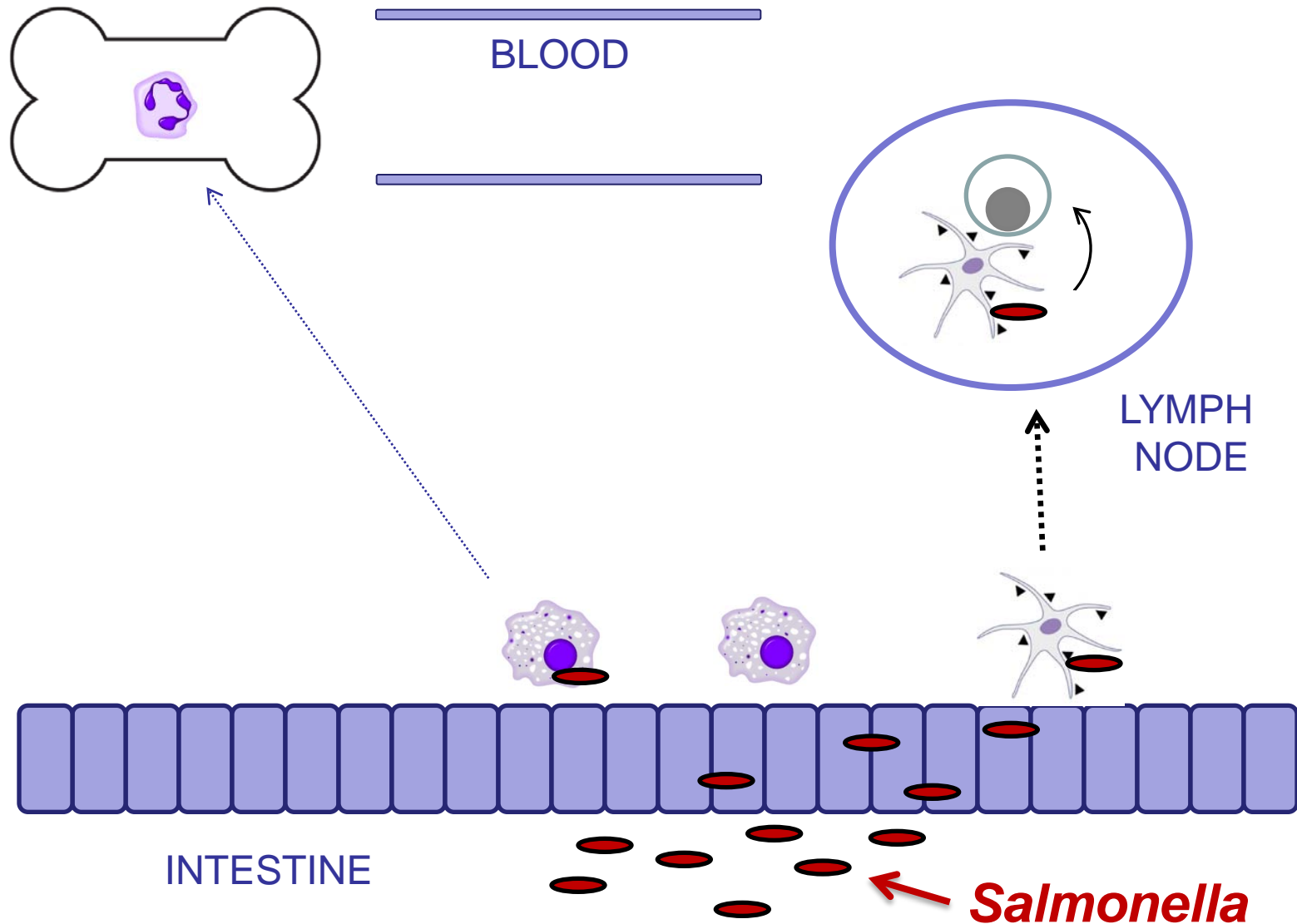
Postcard of Battle Creek Sanatorium, Breathing Exercises, circa 1900



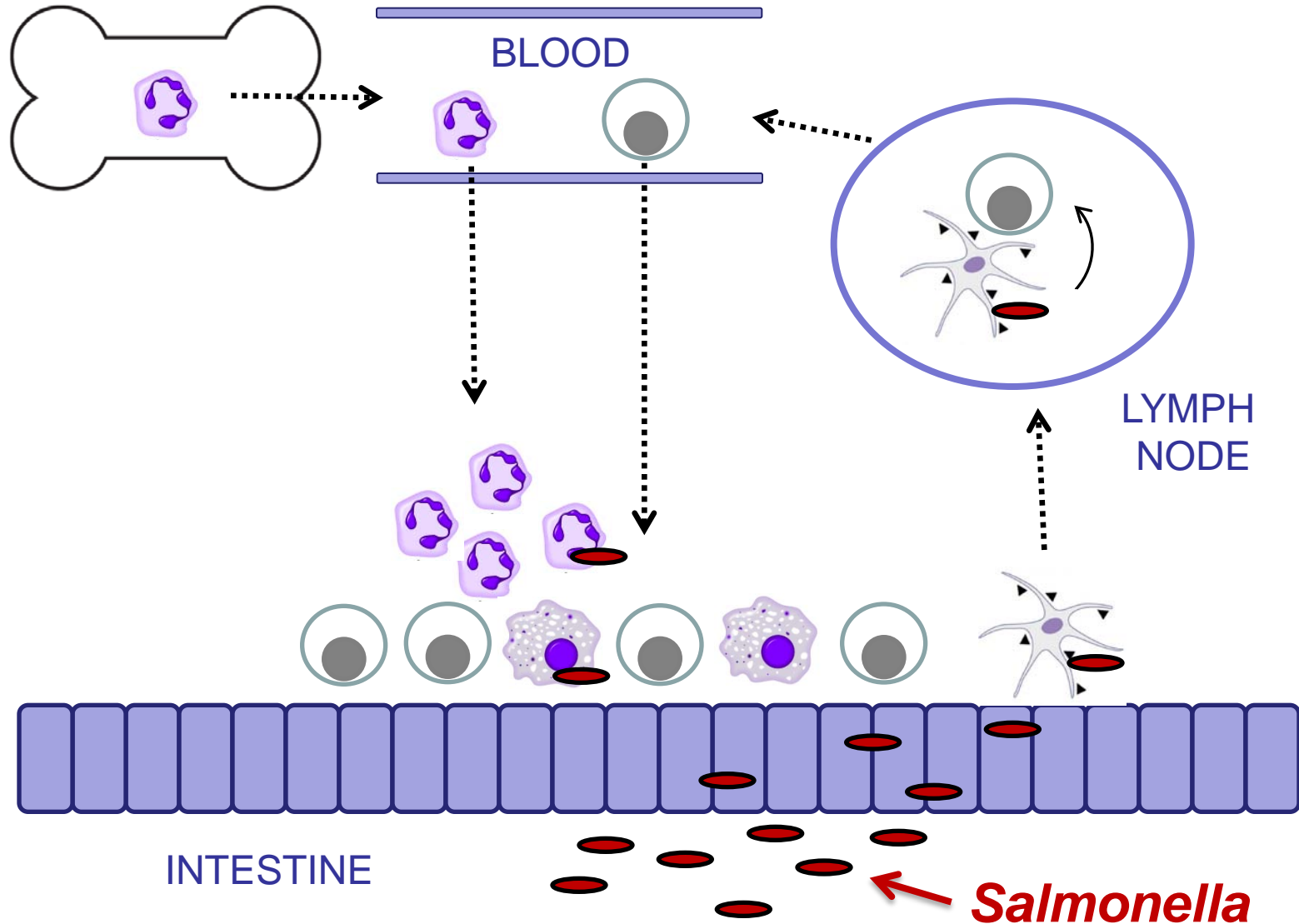
1. Infection/Damage



2. Activation 3. Signals



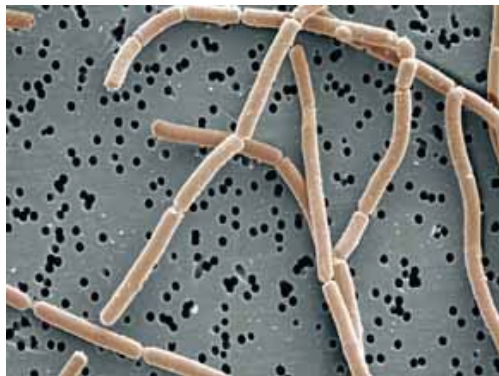
Inflammation ... 4. Resolution



Probiotics Improve Recovery from Gastroenteritis

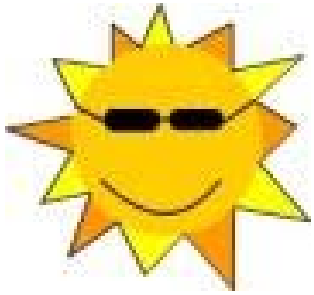
S. Sazawal et al. Lancet Infect Dis 2006 6:374

- Randomized, placebo-controlled trials
 - Decrease duration and severity by 50%
- How?
 - Prevent initial infection/damage
 - Improve resolution



Probiotic bacteria

Lactobacillus rhamnosus GG
L. acidophilus, *L. bulgaricus*
Saccharomyces boulardii



Vitamin D: Improves Recovery from Respiratory Infections?



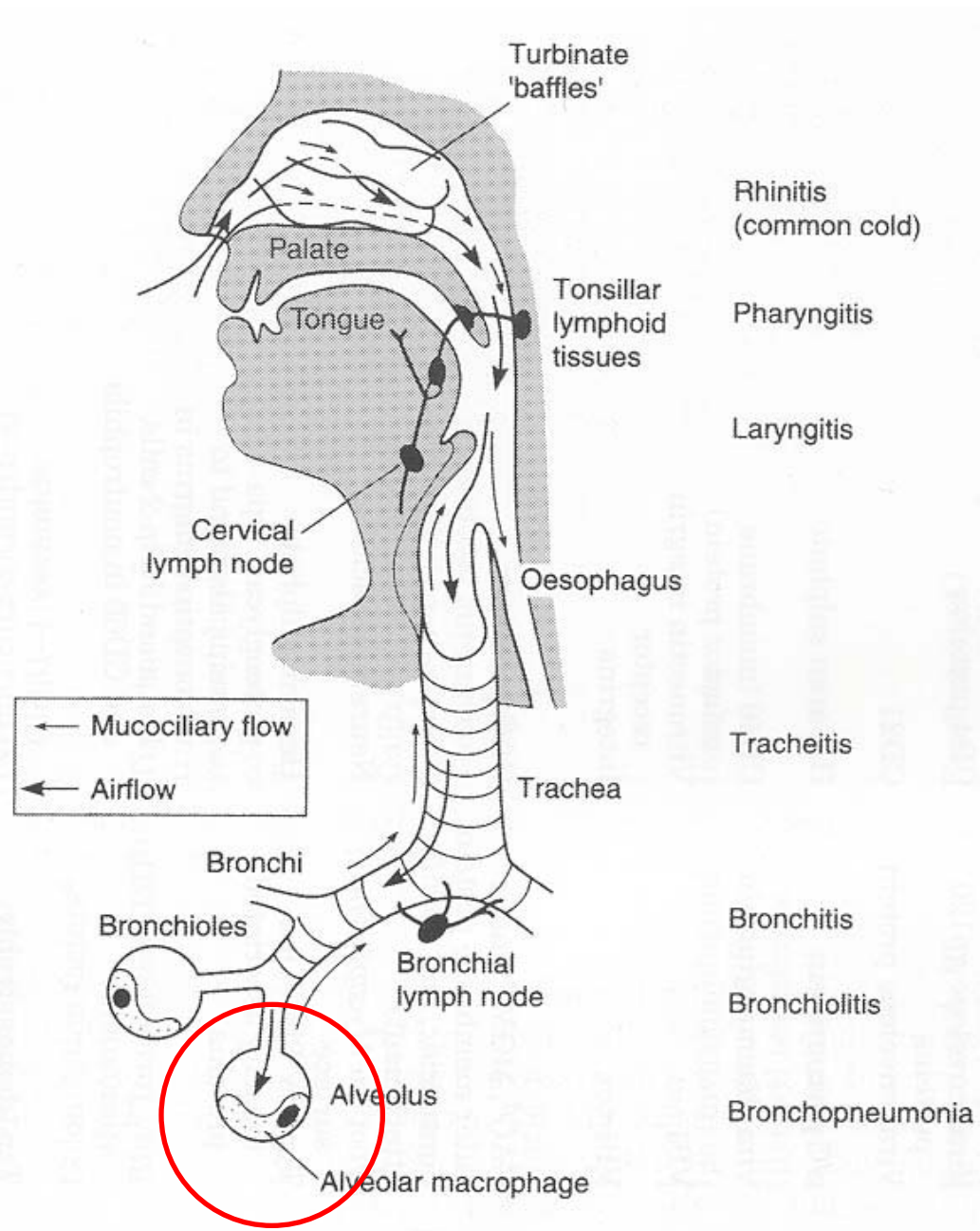
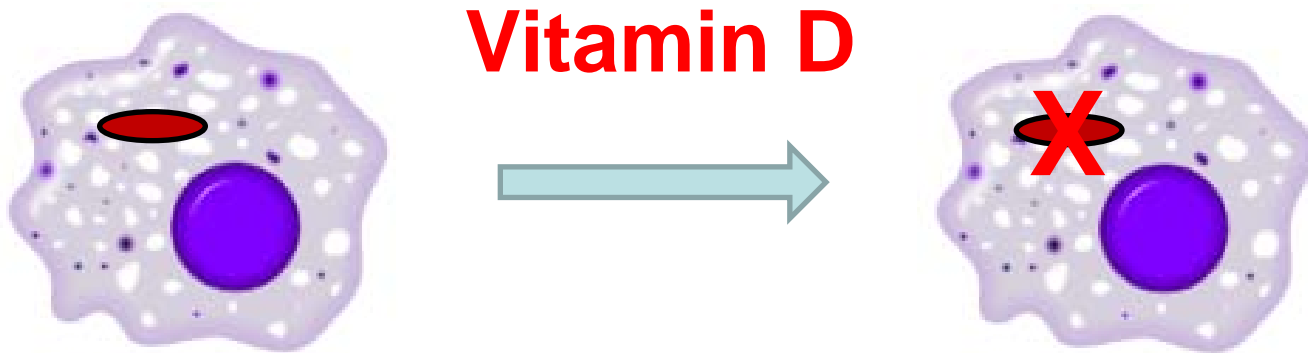


Fig. 2.3 Mechanisms of infection in the respiratory tract.

Activation step of inflammation
stimulates production of the
active form of vitamin D

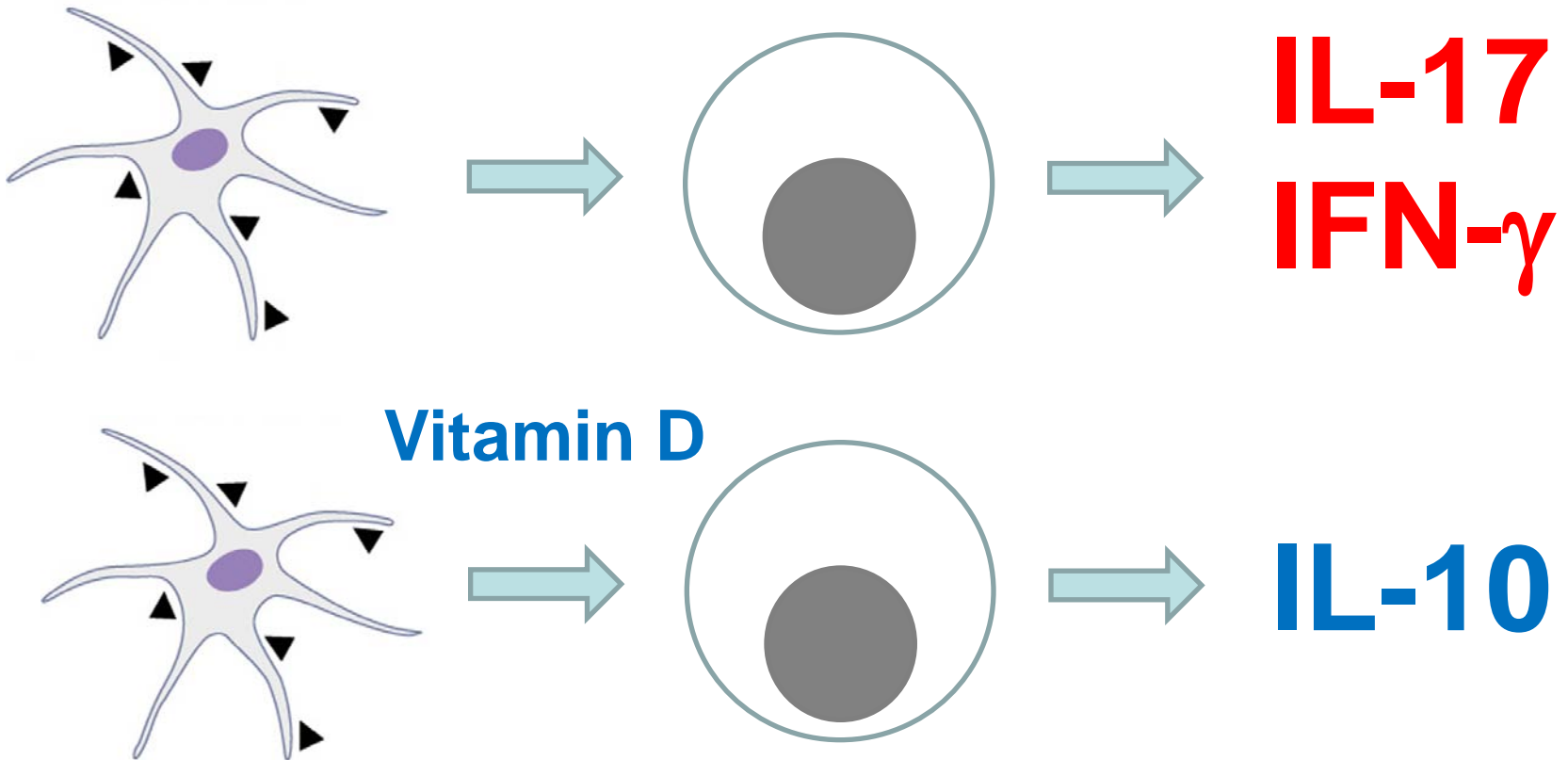


Active vitamin D enhances
killing of bacteria

Vitamin D: Helps Resolve
Chronic Inflammation?

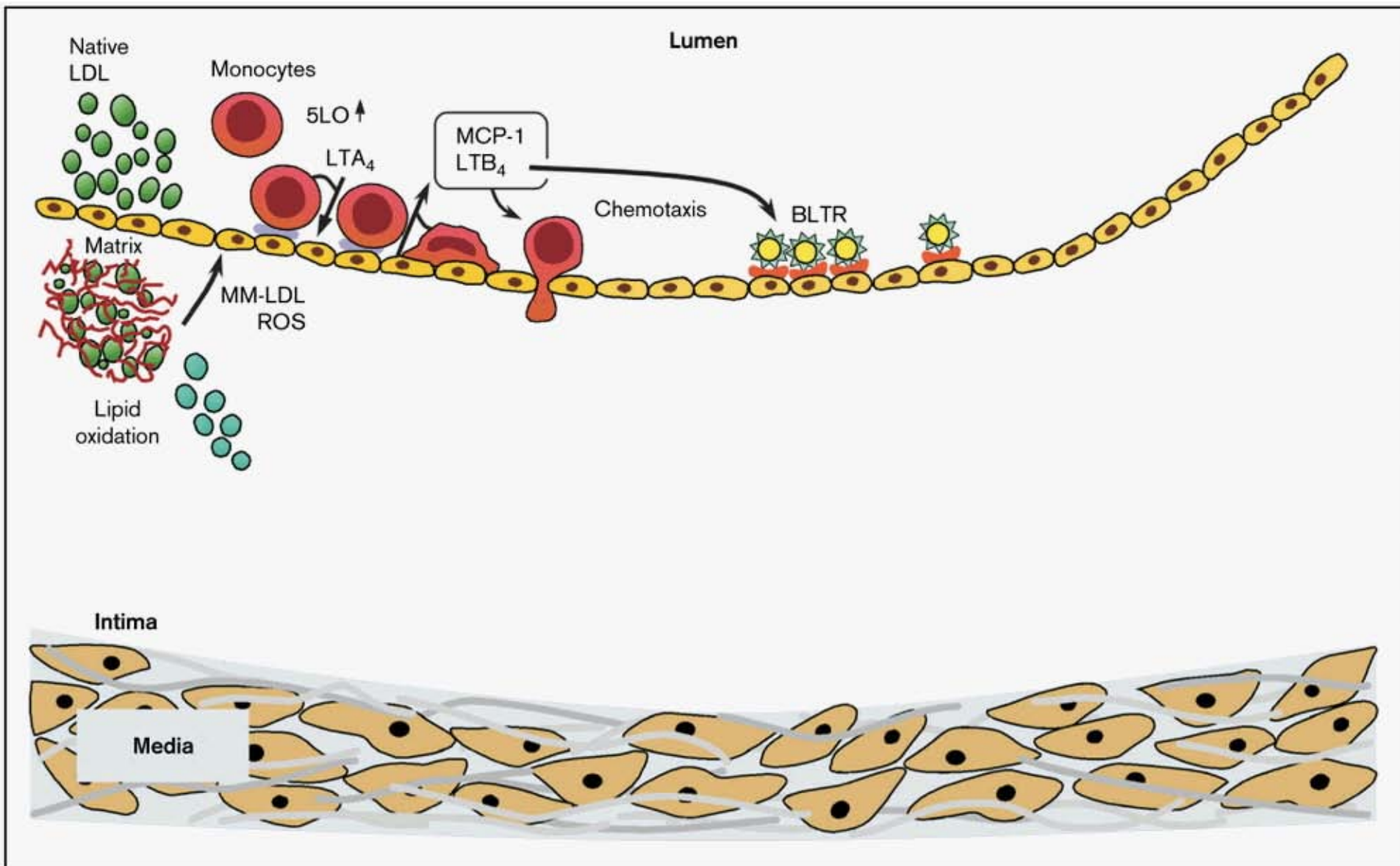
Multiple Sclerosis??

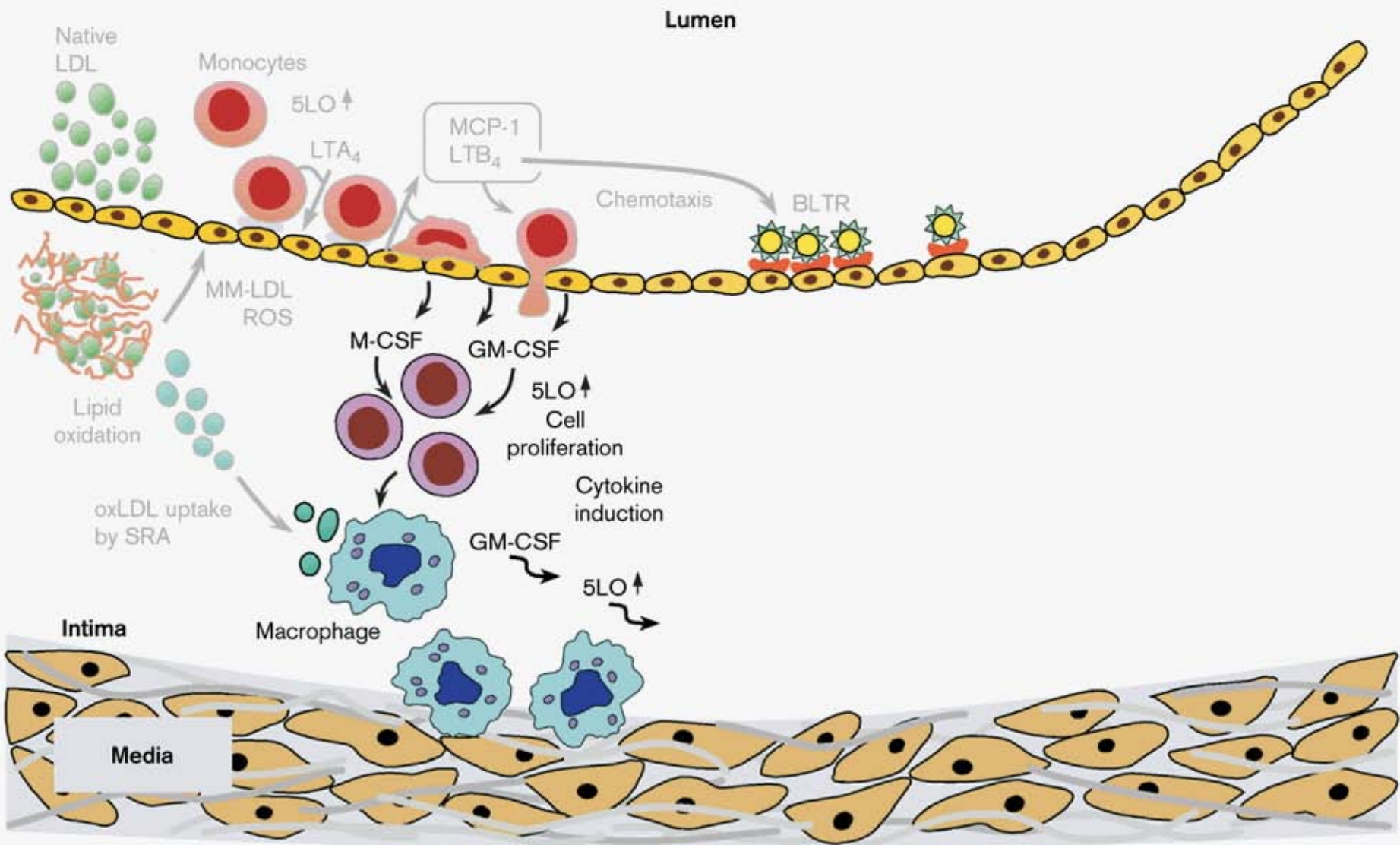
Vitamin D promotes lymphocytes that resolve inflammation

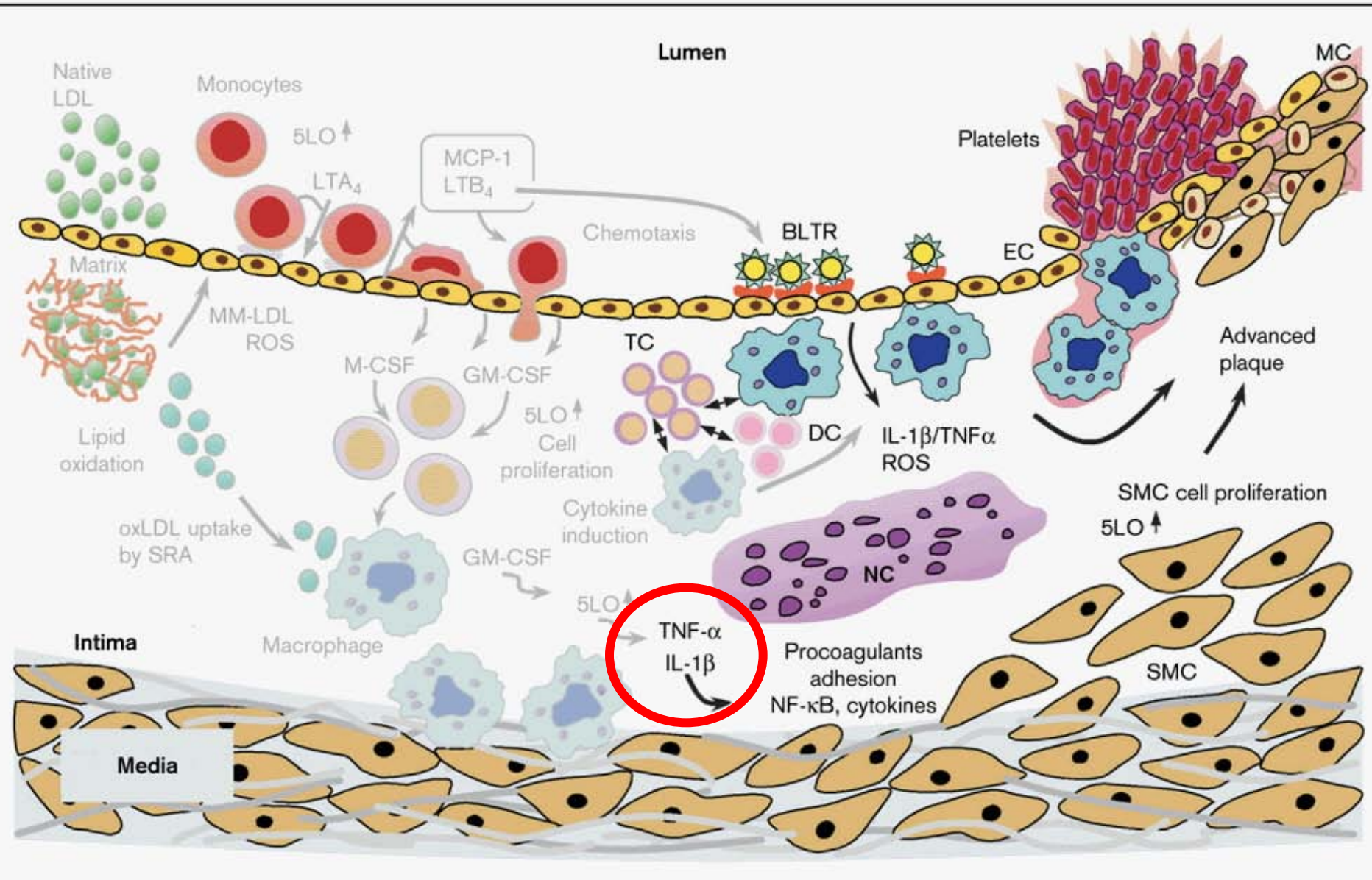


Omega-3 Fatty Acids Help
Resolve Chronic Inflammation

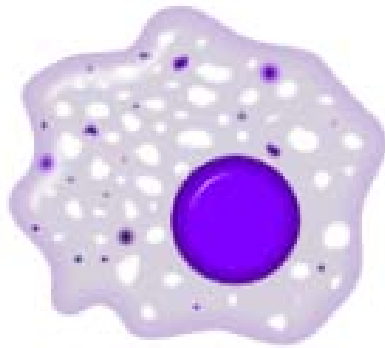
Coronary Artery Disease



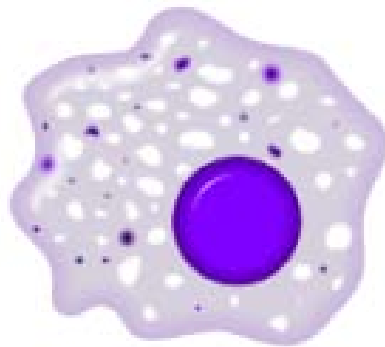




Omega-3 Decreases Production of Pro-Inflammatory Mediators



TNF- α

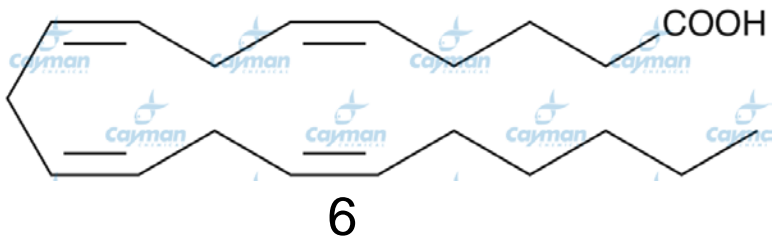


Omega-3

**less
TNF- α**

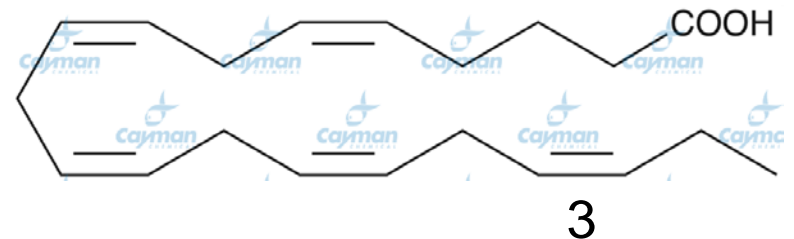
Omega-6 Fatty Acid

**BAD
IN EXCESS**



Omega-3 Fatty Acid

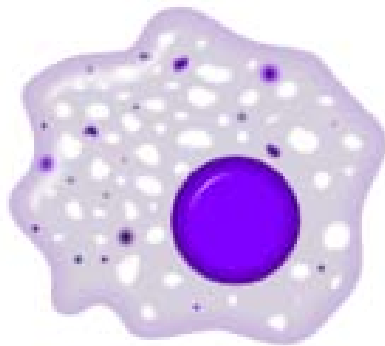
**THE RIGHT
BALANCE IS GOOD!**



Saturated Fatty Acids May
Stimulate Inflammation

Coronary Artery Disease

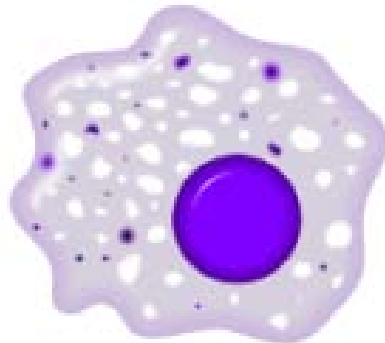
Saturated Fat Increases Production of Pro-Inflammatory Mediators



Saturated Fat



TNF- α



Omega-3



**less
TNF- α**

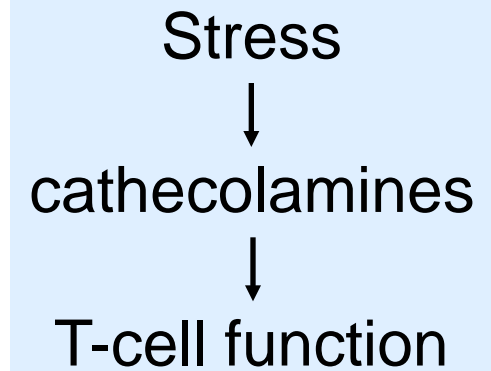
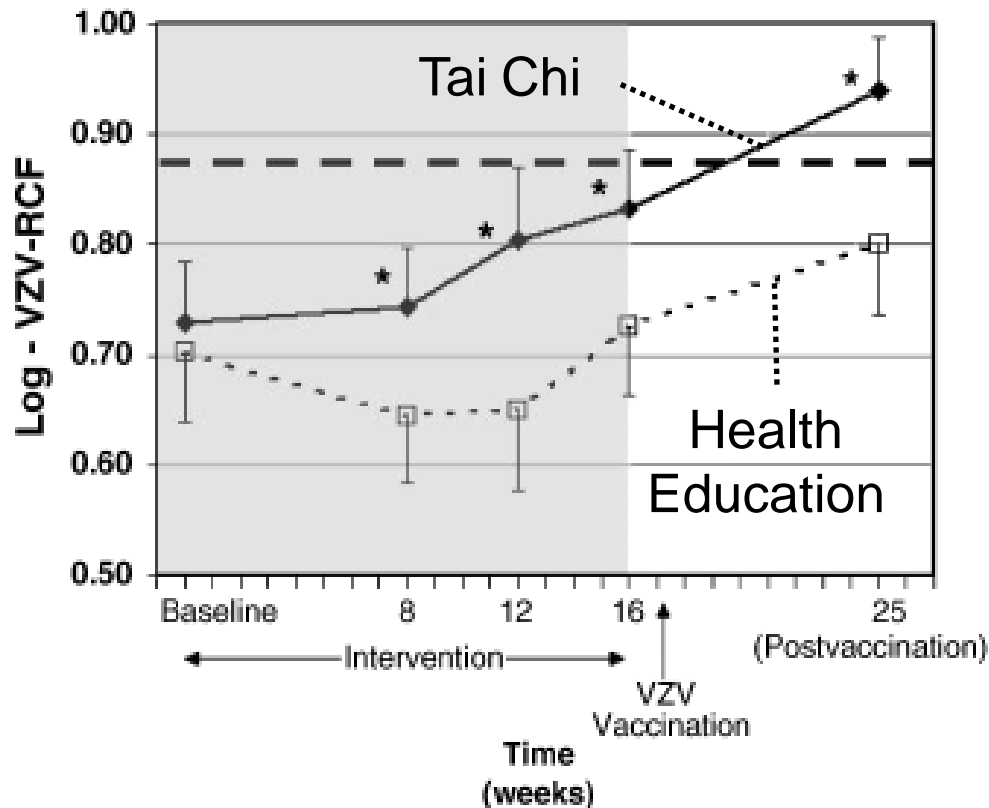
What are saturated fats?

- Saturated fats are usually solid at room temperature. The main sources in the typical American diet are:
 - Lard
 - Beef
 - Whole milk, ice cream
 - Coconut oil
 - Palm oil



The U.S.D.A. recommends
diet and **EXERCISE!**
What about exercise and
inflammation?

Exercise and stress reduction (Tai Chi) enhance response to Chickenpox vaccine



Questions?