

**I. Announcements** Quiz 2 Tuesday covers GI Physiol + Nutrition ≡ Lectures 4, 5 + 6 (*II.* below). Discussion then wbc differential lab! Please read p 5-2 + articles sent by e-mail! By 5 pm Tuesday send nutrition reports to Stacy [aleviche@uoregon.edu](mailto:aleviche@uoregon.edu) or Conor [conoro@uoregon.edu](mailto:conoro@uoregon.edu). Outline update? Q?

**II. Nutrition Connections** Sodium, US diabetes trends, exercise?

**III. Blood + Body Resistance to Infection I**

G&H ch 32, 33, LS, Stuart Fox, Daniel Chiras (DC), Basiro Davey

A. Blood: cell + fragments vs liquid (plasma vs serum) LS

B. Red blood cells, white blood cells, platelets, Demo? LS, DC

C. Red blood cell production, hemoglobin G&H pp 413-9

G&H fig 32-1 thru 32-6 +..., Fox

D. Pathogen? Microbe that causes disease, Davey pp 5-6

E. Barriers to infection Davey fig 2.1 p 12, fig 2.2 p 13

F. *National Geographic*, *The Wars Within*, Lennart Nilsson

<http://www.lennartnilsson.com/>

G. WBC effectors: Innate & adaptive immunity G&H pp 433-7

G&H fig 34-1 + Davey fig 2.2 p 13, fig 3.4 p 24, fig 3.12 p 36

H. [Medical Physiology News](#) Handwashing to prevent infection!

US Centers for Disease Control

# NUTRITION SCORECARD (PER SERVING)

SODIUM  
**50**mg

FAT  
**2.5**g

FIBER  
**4**g

ANTIOXIDANT  
**45%** RDI\*

\*VITAMIN A



**NO SALT ADDED**  
**Vegetable**  
SOUP



NET WT  
15 OZ (425g)

Our Organic Vegetable Soup is made with the finest ingredients and has **No Salt Added**. It is also an excellent source of antioxidant vitamin C (20%) and antioxidant vitamin A (45%) and a good source of fiber (4g).



Na+ Na+  
Na+...Help!

**READY TO SERVE - DO NOT ADD WATER**

**STOVE:** Heat, stir as necessary.

**MICROWAVE:** Heat in a covered microwave safe bowl on HIGH for about 2 minutes or until hot. Remove carefully.

**QUESTIONS/COMMENTS:** 1-800-434-4246, or visit [www.healthvalley.com](http://www.healthvalley.com).

Nutrition Facts	Amount/serving	% DV*	Amount/serving	% DV*
	<b>Total Fat</b> 2.5g	<b>4%</b>	<b>Total Carb.</b> 18g	<b>6%</b>
Sat. Fat 0g	<b>0%</b>	Dietary Fiber 4g	<b>16%</b>	
<i>Trans Fat</i> 0g		Sugars 4g		
<b>Cholest.</b> 0mg	<b>0%</b>	<b>Protein</b> 3g	<b>5%</b>	
<b>Sodium</b> 50mg	<b>2%</b>			
*Percent Daily Values (DV) are based on a 2,000 calorie diet.				
Vitamin A 45% • Vitamin C 20% • Calcium 4% • Iron 8%				

This Health Valley Organic Soup contains 50 milligrams sodium per serving. Other leading brands contain 860 milligrams sodium or more per serving. This is not a sodium free food.

**Exchanges:**  
2 Vegetable, 1/2 Starch

**MADE WITH NO GENETICALLY ENGINEERED INGREDIENTS.**

† Can lining not derived from BPA

X2071-008



Leading brands ≥ 860 mg per serving!

If whole can x2!

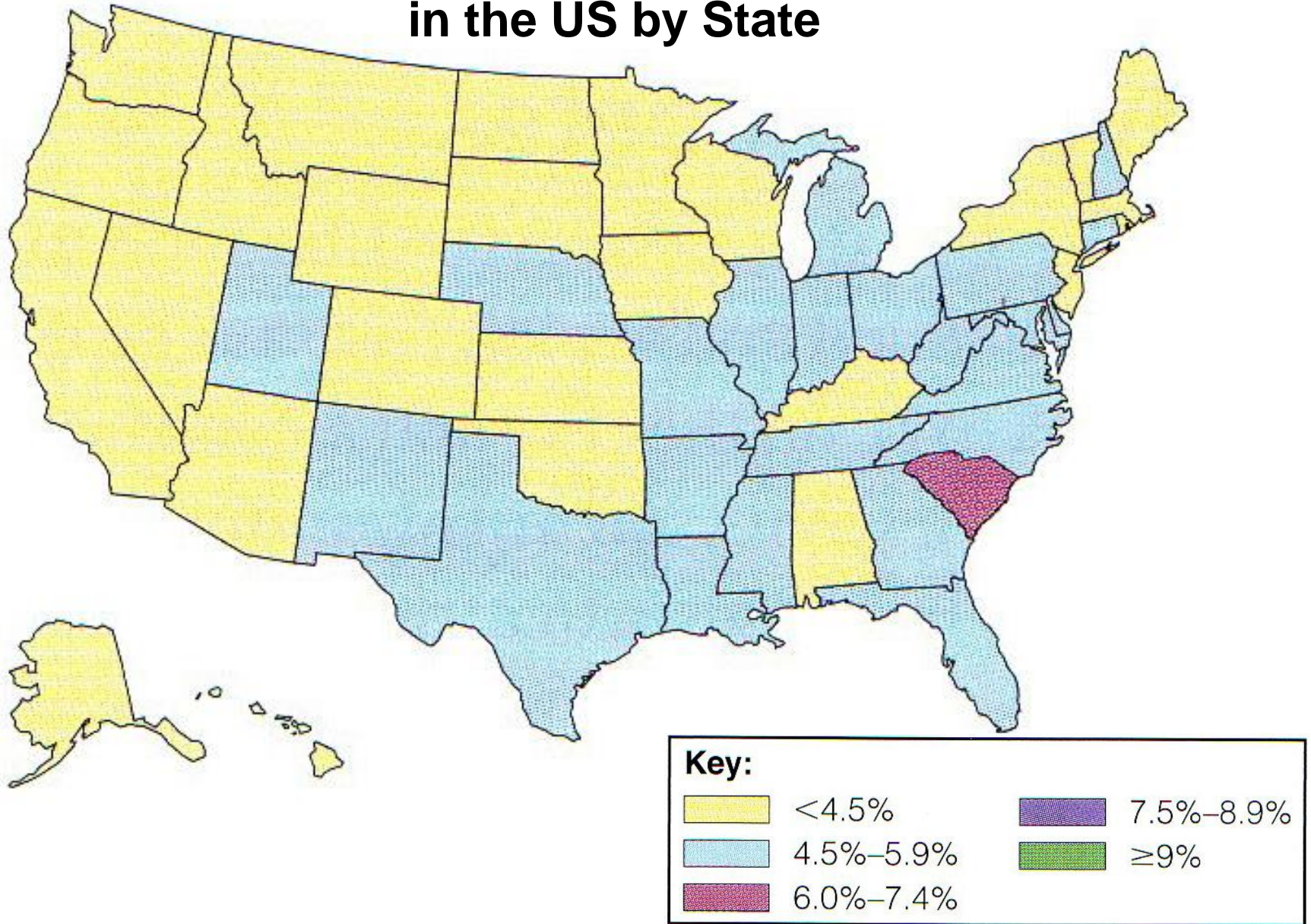
Vit A	90%
Vit C	40%
Ca <sup>2+</sup>	8%
Fe <sup>2+</sup>	16%

**INGREDIENTS:** FILTERED WATER, ORGANIC POTATOES, ORGANIC CARROTS, ORGANIC CELERY, ORGANIC TOMATOES, ORGANIC PEAS, ORGANIC GREEN BEANS, ORGANIC CORN, ORGANIC ONIONS, ORGANIC TOMATO PASTE, ORGANIC CORN STARCH, ORGANIC BROCCOLI, ORGANIC RED KIDNEY BEANS, ORGANIC EXPELLER PRESSED CANOLA OIL, ORGANIC EVAPORATED CANE JUICE, ORGANIC SPINACH, ORGANIC ONION POWDER, ORGANIC GARLIC GRANULES, ORGANIC SPICES, ORGANIC CONCENTRATED LEMON JUICE, ORGANIC WHITE PEPPER, ORGANIC CAYENNE PEPPER, VITAMIN A PALMITATE.

**MANUFACTURED FOR DISTRIBUTION BY:**  
THE HAIN CELESTIAL GROUP, INC., LAKE SUCCESS, NY 11042 USA  
**CERTIFIED ORGANIC BY QUALITY ASSURANCE INTERNATIONAL (QAI)**  
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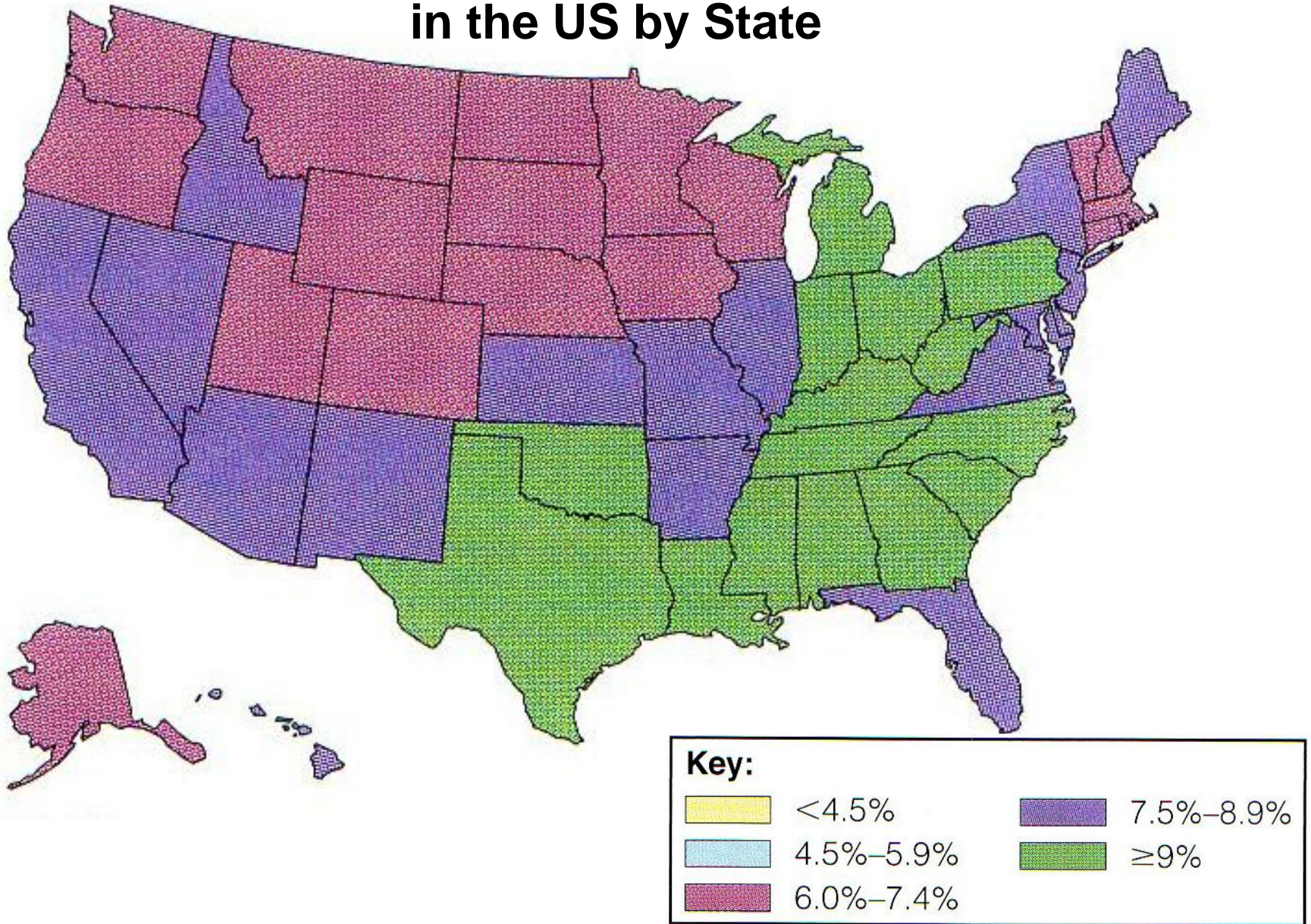


# 1994 Diabetes Prevalence in the US by State



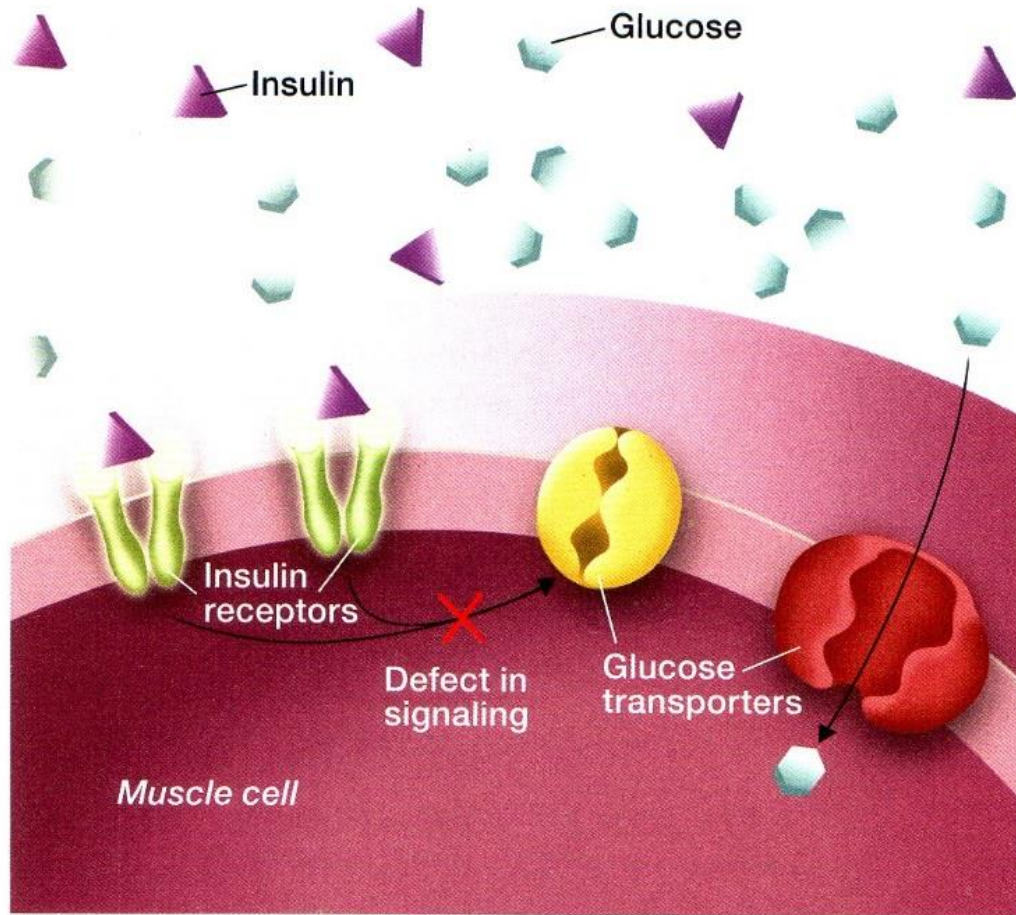
Source: Centers for Disease Control, Division of Diabetes Translation,  
<http://www.cdc.gov/diabetes/statistics>, S&W 2014 fig 4-15 p139A.

# 2010 Diabetes Prevalence in the US by State



Source: Centers for Disease Control, Division of Diabetes Translation,  
<http://www.cdc.gov/diabetes/statistics>, S&W 2014 fig 4-15 p139B.

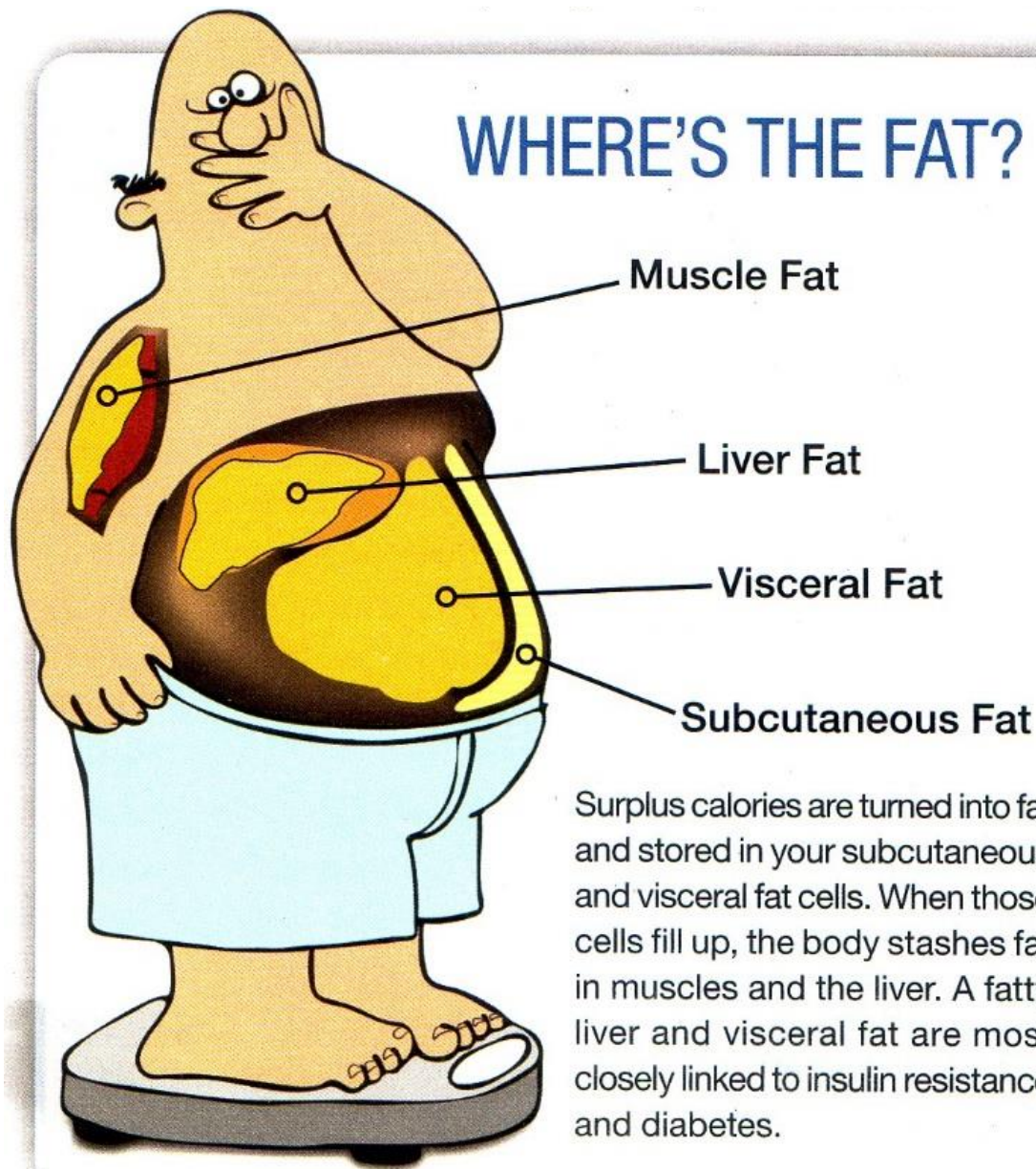
# INSULIN RESISTANCE



**SOURCE:**  
Decoding diabetes.  
*Nutrition Action  
Health Letter*, June  
2011, pp 4.

When insulin docks in the receptors on cell membranes, that should signal glucose transporters to let glucose (blood sugar) into the cell. But if you are insulin resistant, some glucose transporters never get the message. (Others don't need insulin to let glucose in.) That leaves excess glucose in the blood, so the pancreas has to pump out more insulin. If it can't keep up, blood sugar rises and you have diabetes.

## WHERE'S THE FAT?



Surplus calories are turned into fat and stored in your subcutaneous and visceral fat cells. When those cells fill up, the body stashes fat in muscles and the liver. A fatty liver and visceral fat are most closely linked to insulin resistance and diabetes.

# The Bottom Line

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- The best way to dodge diabetes is to lose (or not gain) extra pounds.
- Limit sweets, especially sugar-sweetened drinks. Even the naturally occurring sugars in 100% fruit juice may raise your risk.
- Eat leafy greens, whole grains, beans, and nuts to boost your magnesium.
- Get the RDA for vitamin D (600 IU a day up to age 70 and 800 IU over 70) from supplements or foods fortified with vitamin D.
- Do *at least* 30 minutes of brisk walking or other aerobic exercise every day.
- Shoot for 2 or 3 strength training sessions a week. Each should include 8 to 12 repetitions of 8 to 10 exercises.

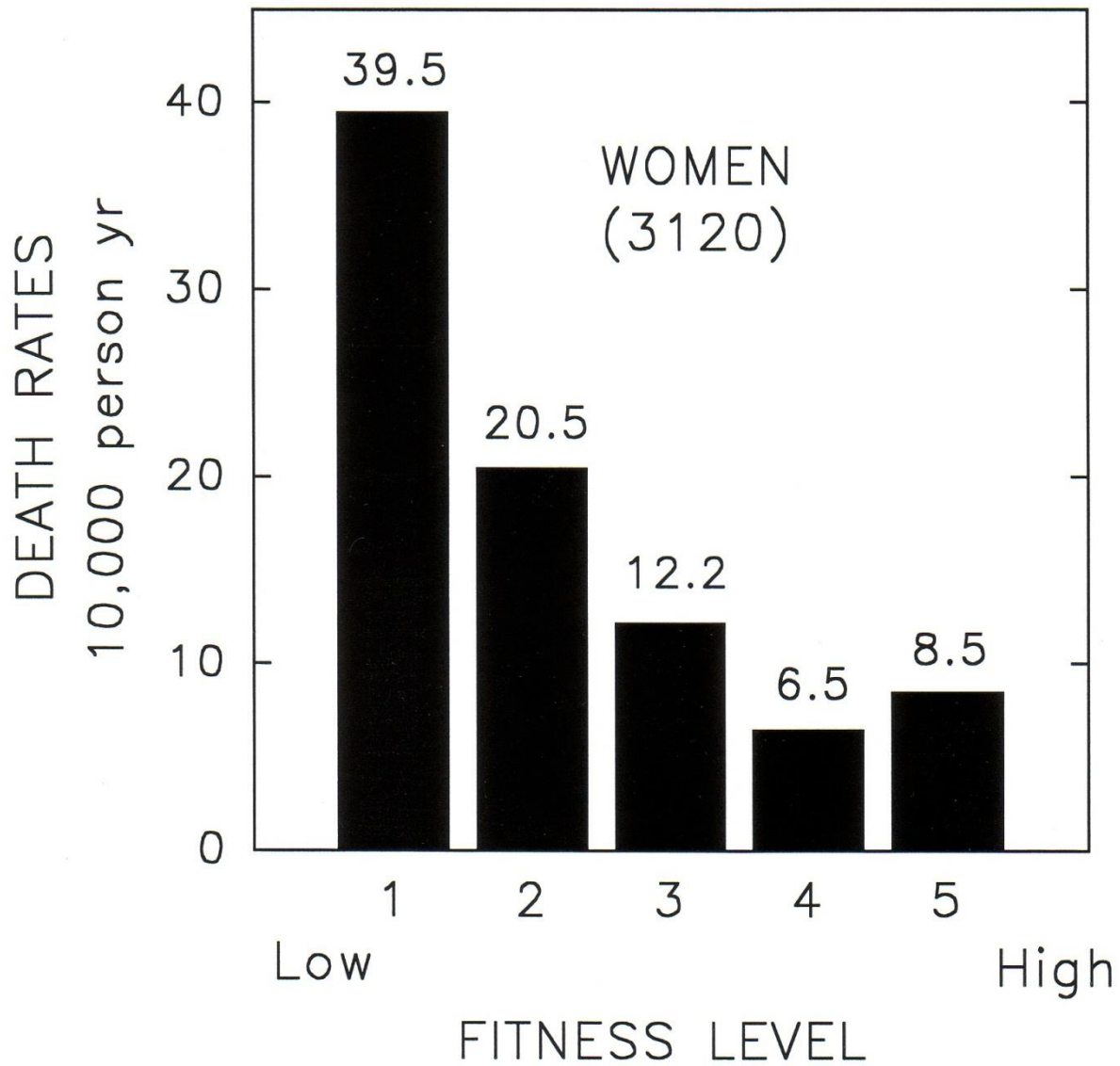
**SOURCE:** Decoding diabetes. *Nutrition Action Health Letter*, June 2011, pp 3.



Why exercise?



# THE REWARD OF FITNESS: LONGEVITY



**SOURCE:** SN Blair & associates, JAMA, 1989, 263(15), 2395-401.

***Exercise is a must based on  
its insulin-like effect!***



## *100s of other reasons! Exercise –*

↑ lean body mass, ↑ cardiac output,  
↑ myocardial contractility, ↑ central &  
peripheral blood flow, ↑ fibrinolytic activity,  
↑ HDL cholesterol, ↑ work capacity,  
↑ sleep quality, ↓ % body fat,  
↓ TOT & LDL cholesterol, ↓ triglycerides, ↓  
platelet aggregation, ↓ blood pressure,  
↓ CVD risk,...



**AMERICAN COLLEGE**  
of **SPORTS MEDICINE**

## **Guidelines: Healthy Adults < 65 yr**

American Heart  
Association®   
*Learn and Live™*

**Do moderately intense aerobic exercise  
30 min/d, 5 d/wk**

**OR**

**Do vigorously intense aerobic exercise  
20 min/d, 3 d/wk**

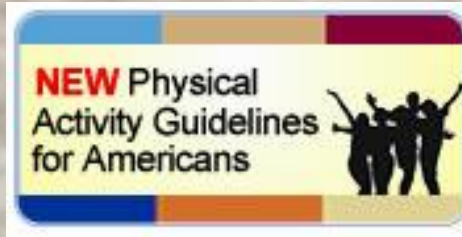
**AND**

**Do 8-10 strength-training exercises  
8-12 repetitions/each exercise, 2 d/wk**

<http://www.acsm.org/access-public-information/position-stands>

<http://www.acsm.org/access-public-information/brochures-fact-sheets/fact-sheets>

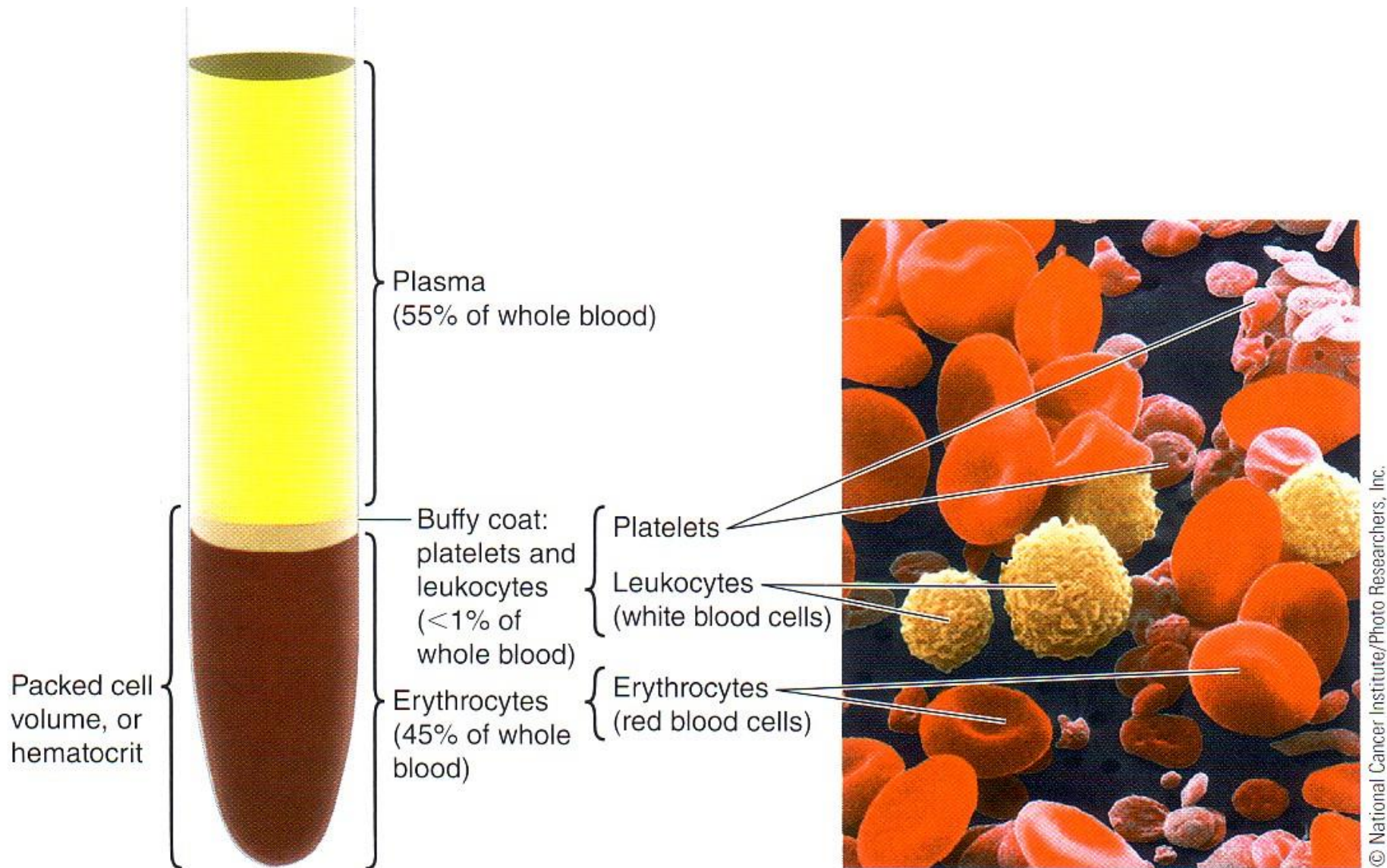
**Federal exercise guidelines include strength training for all**  
<http://www.cdc.gov/physicalactivity/everyone/guidelines/index.html>  
<http://www.health.gov/paguidelines/>

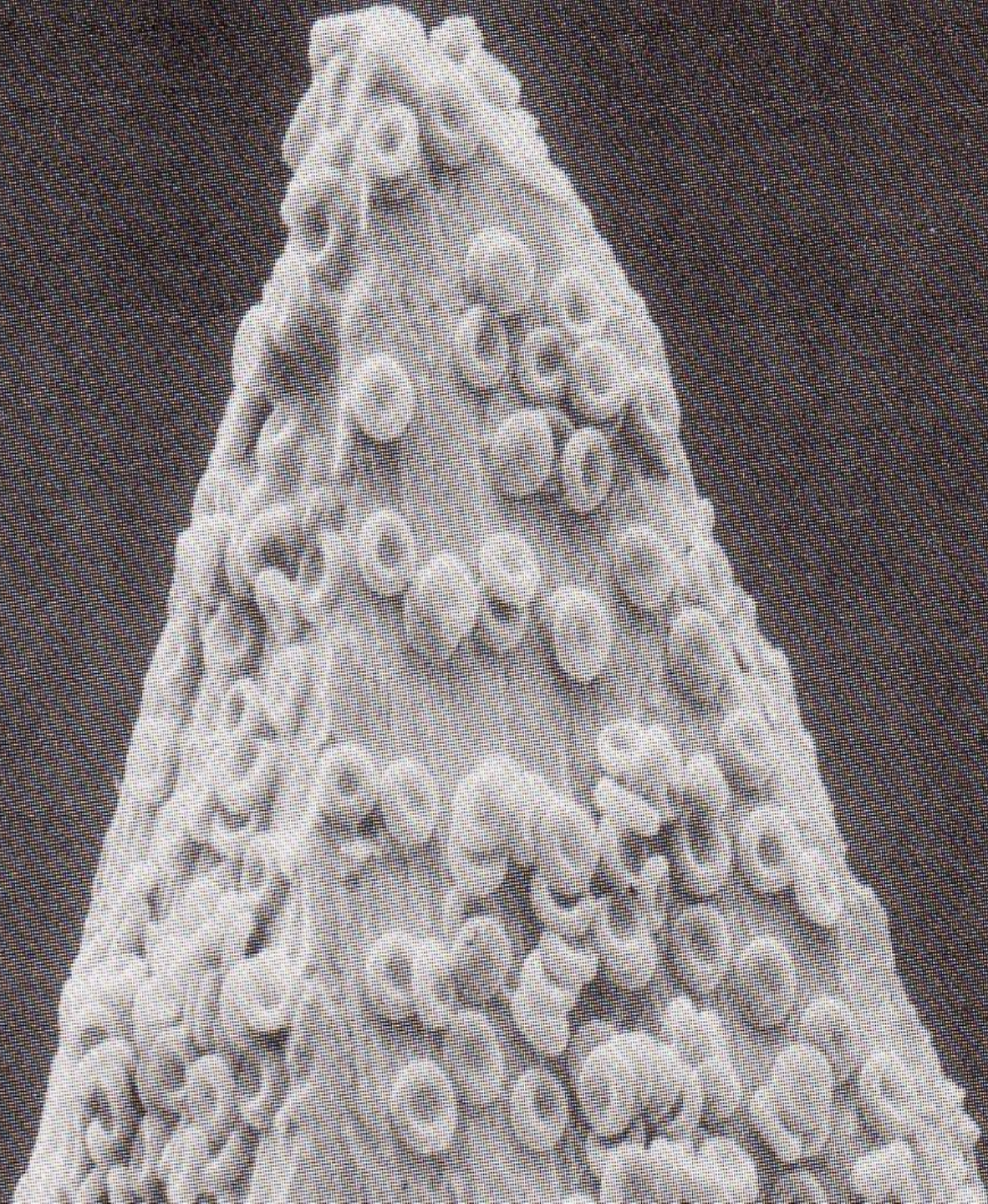


**Adults: Moderate to Vigorous Exercise  $\geq$  30 min, 5 d/wk**

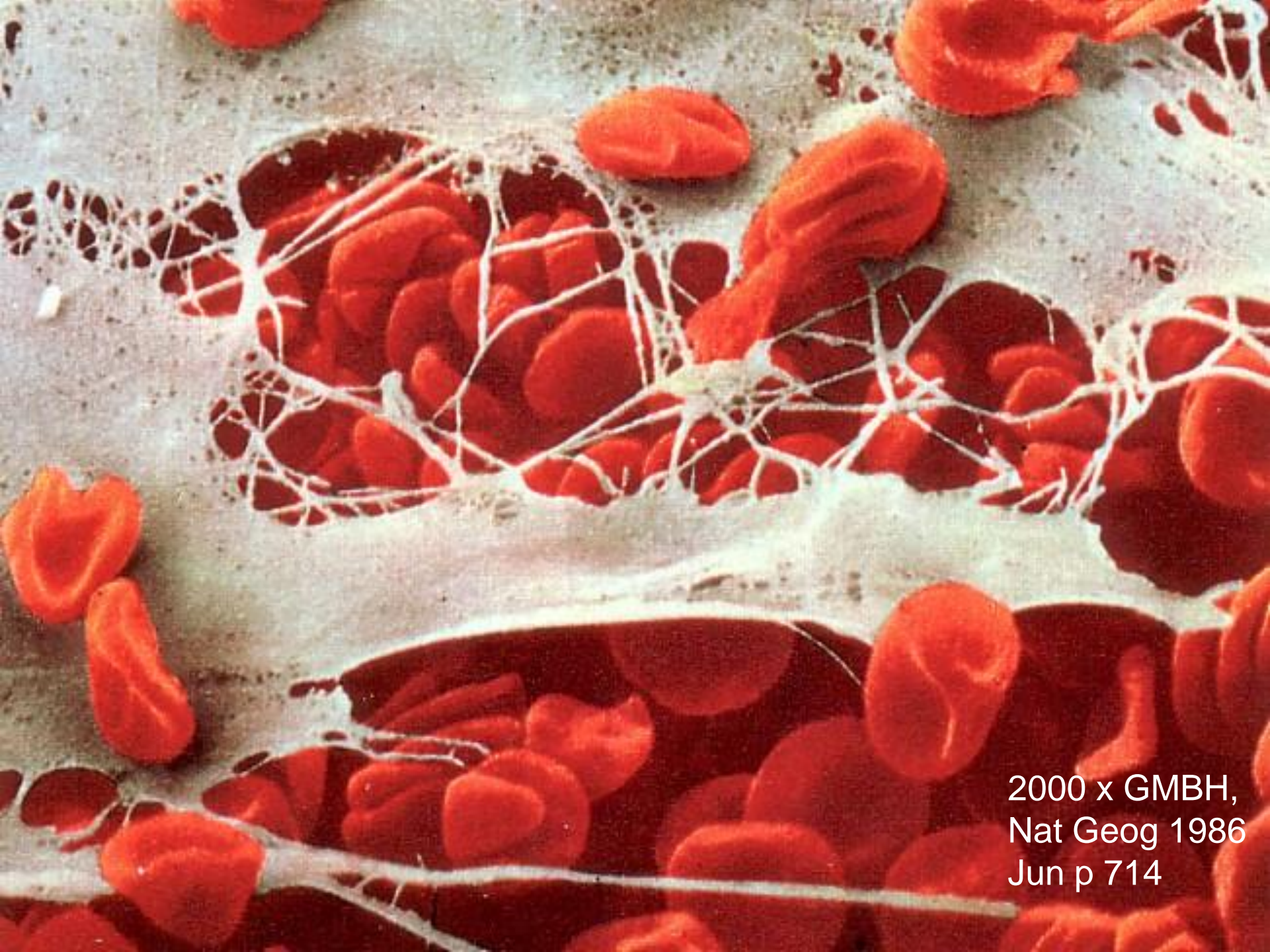
**Children: Moderate to Vigorous Exercise  $\geq$  60 min, 5 d/wk**

# What's in Blood? Plasma & Blood Cells



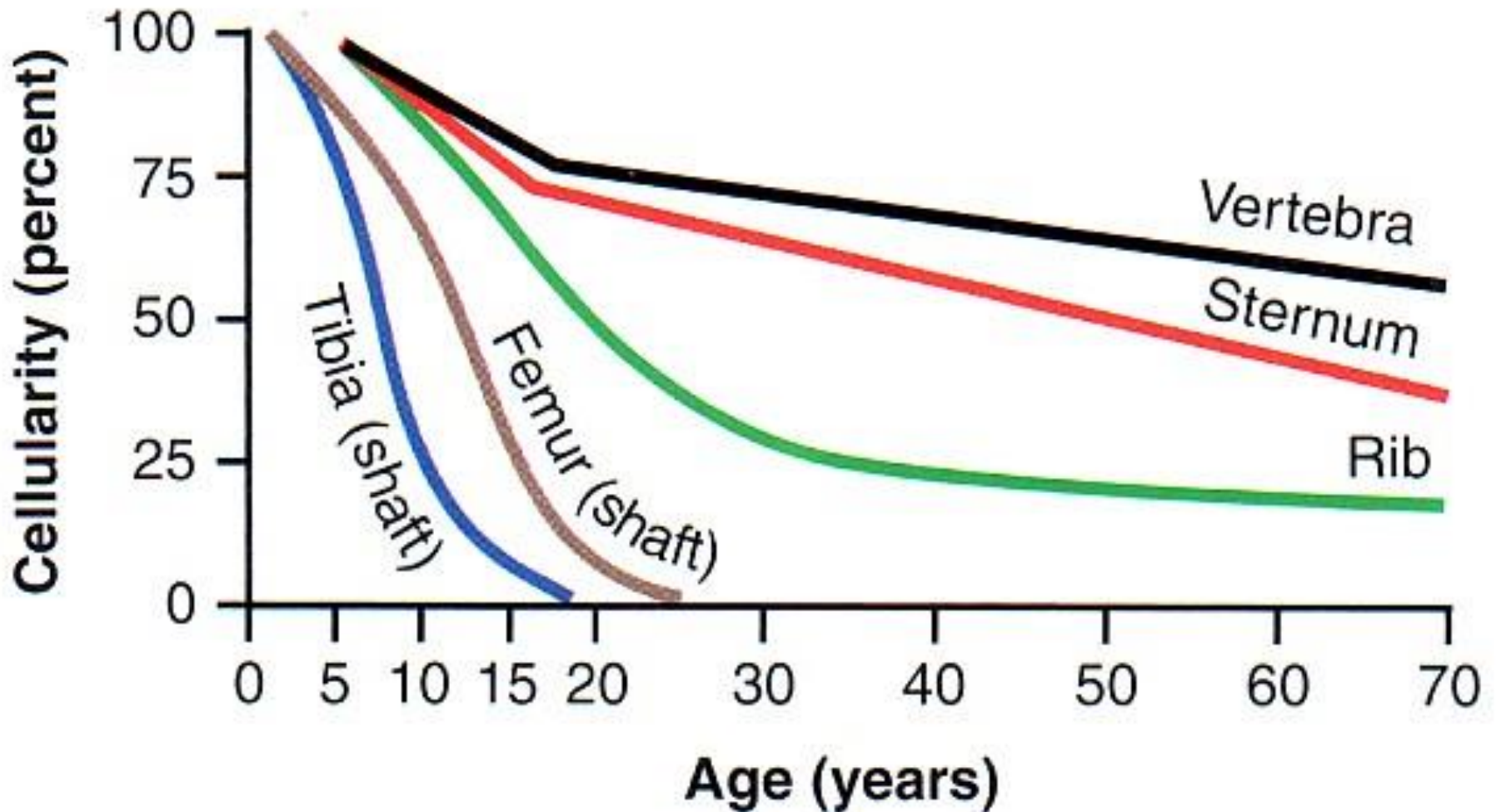




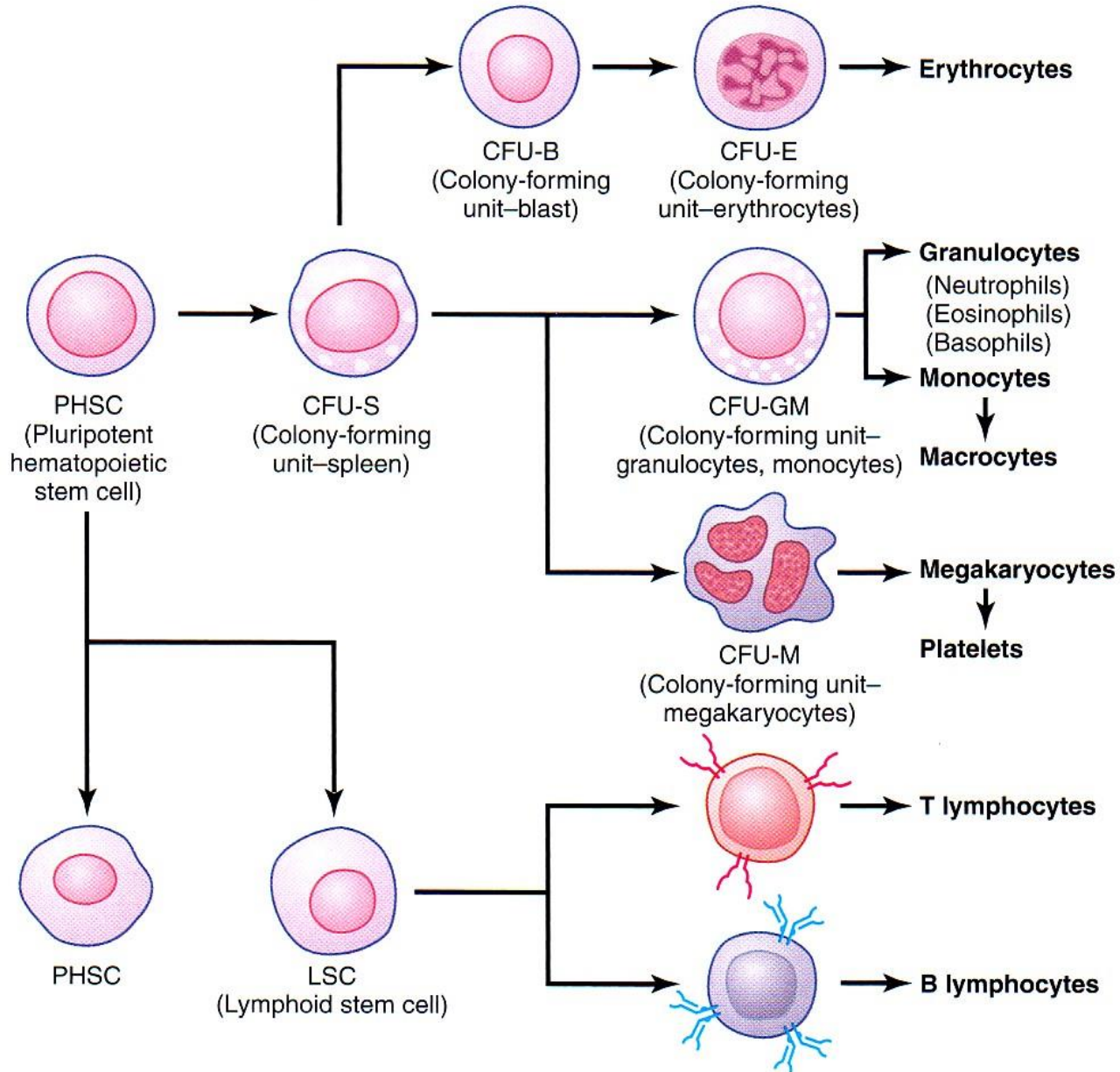


2000 x GMBH,  
Nat Geog 1986  
Jun p 714

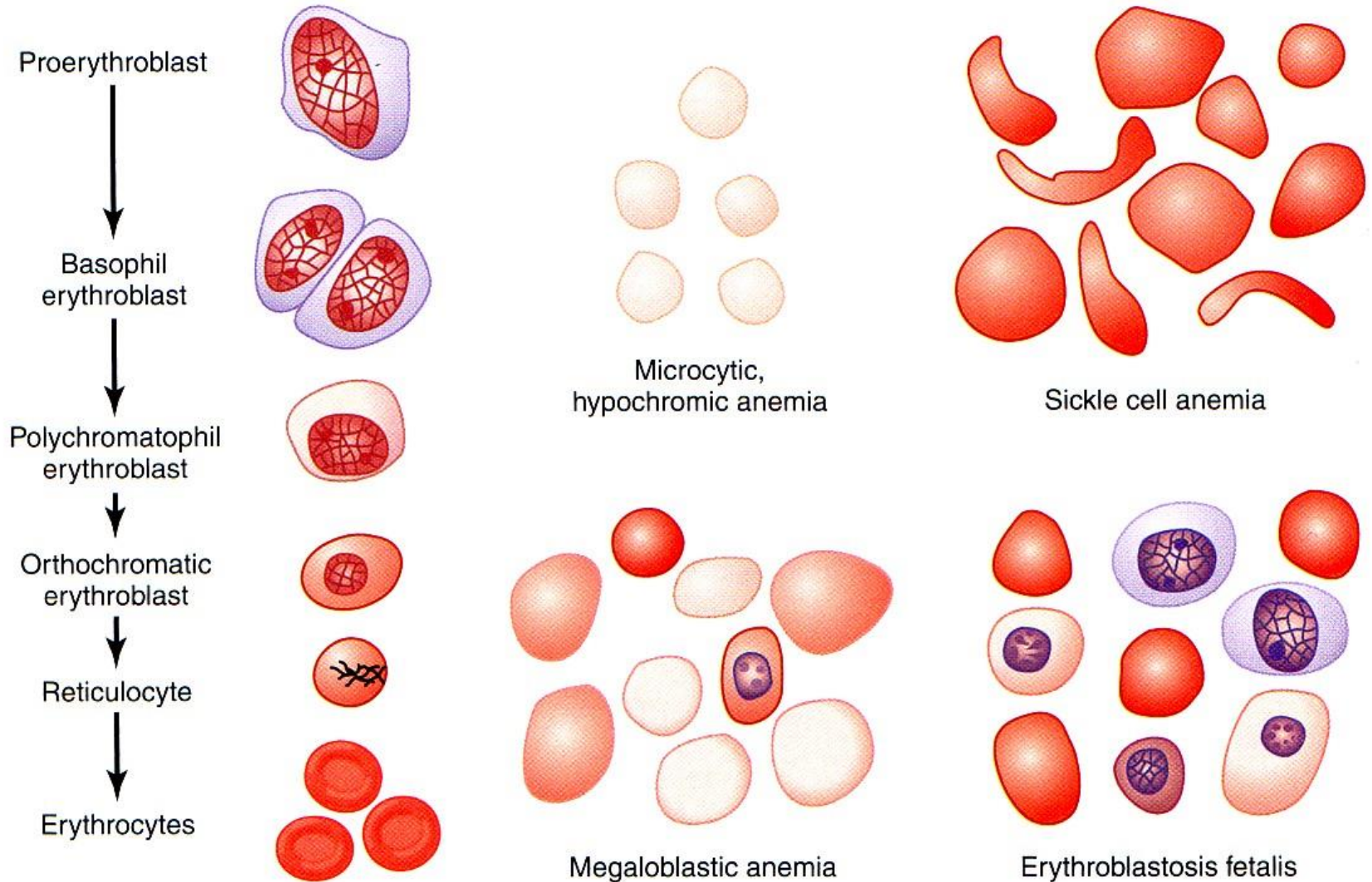
# *Dermal bone production of red blood cells*



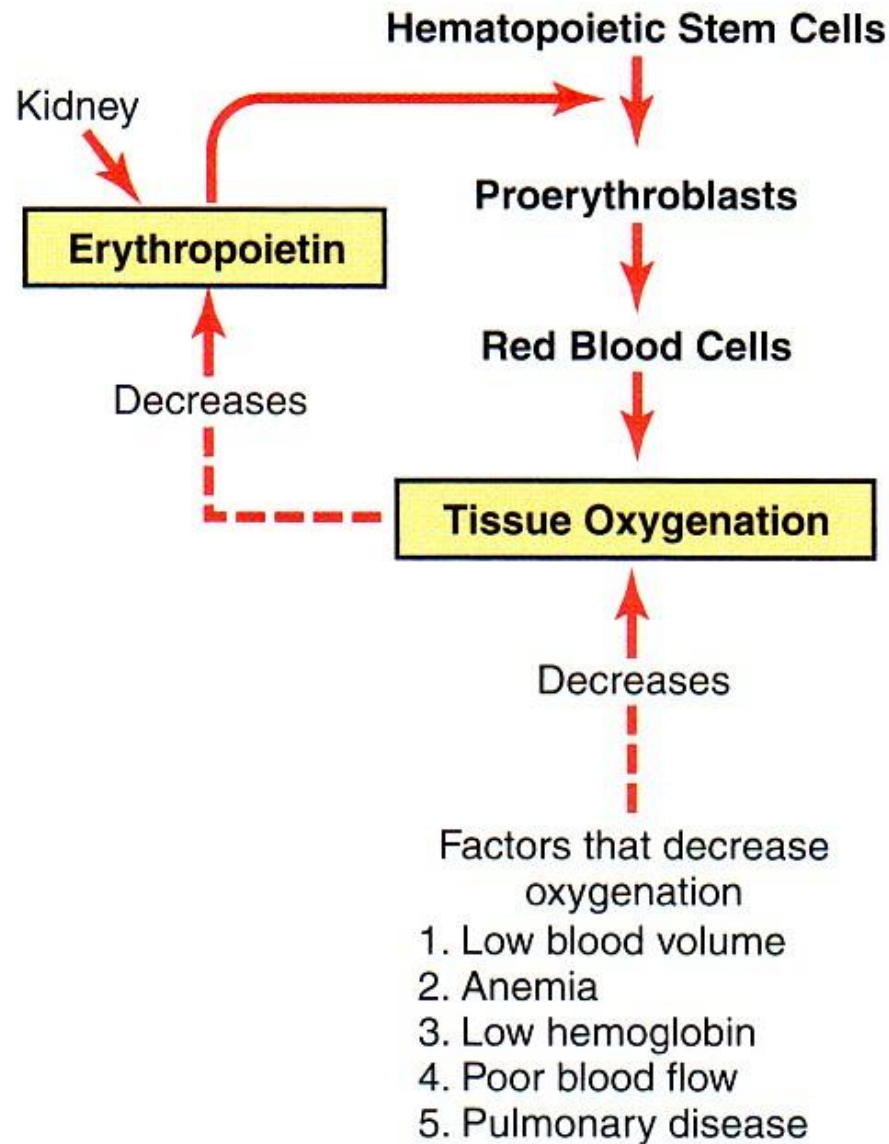
# Pluripotent Hematopoietic Stem Cell Lines



# Red Blood Cell Genesis

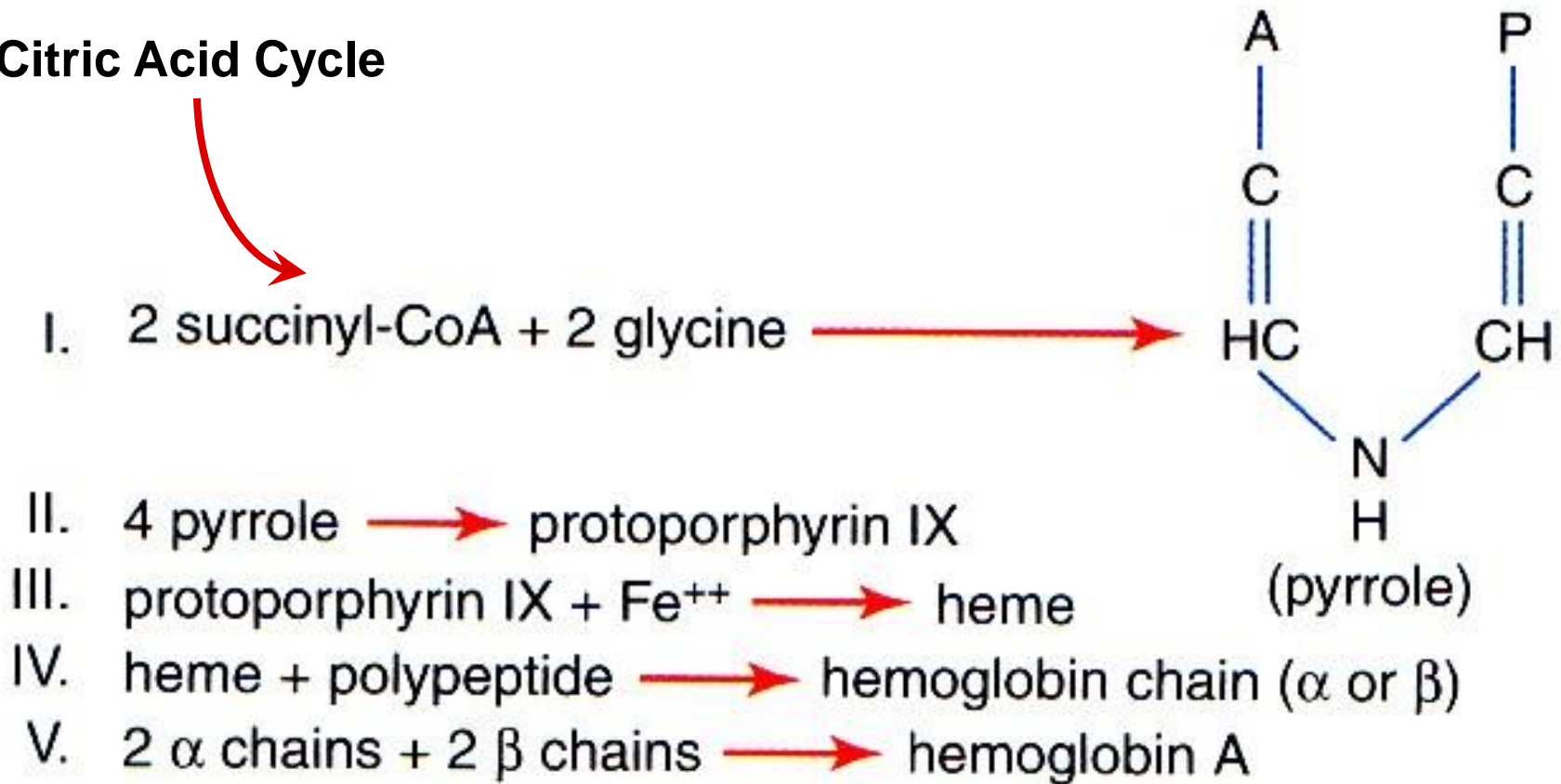


# Erythropoietin Regulates RBC Production

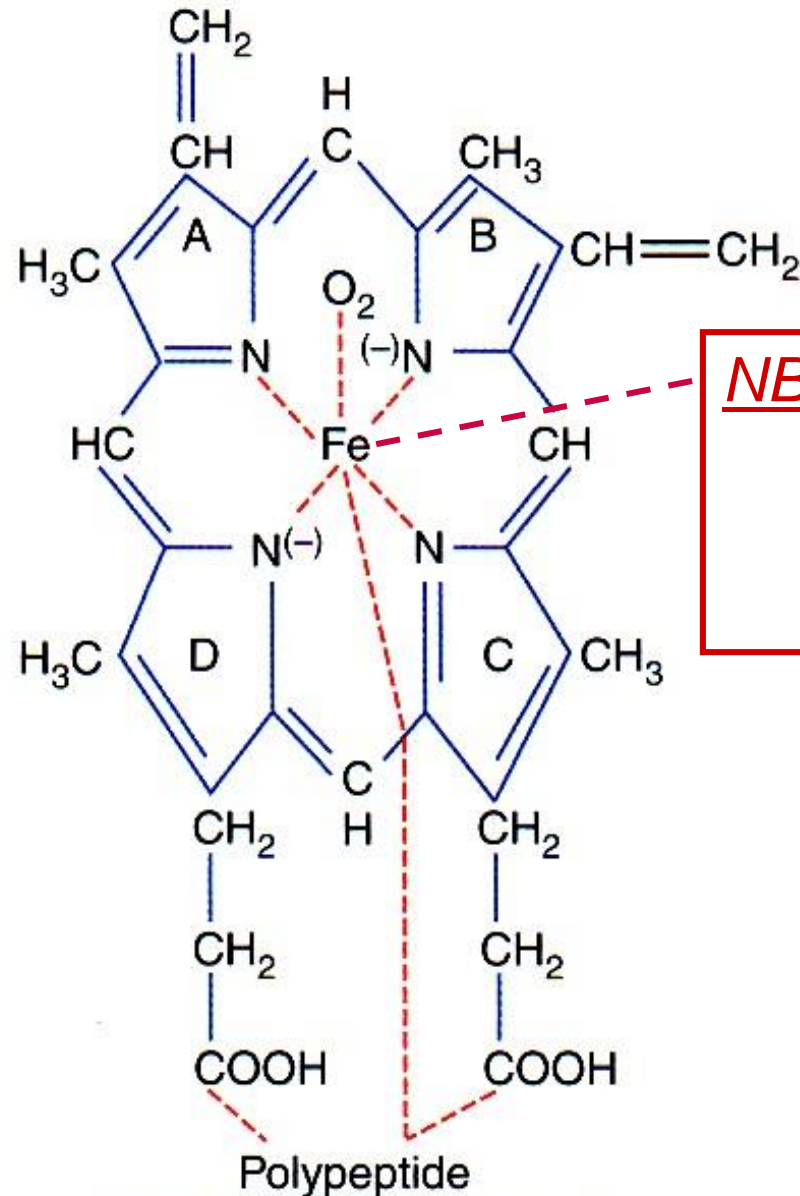


# Hemoglobin Formation

## Citric Acid Cycle

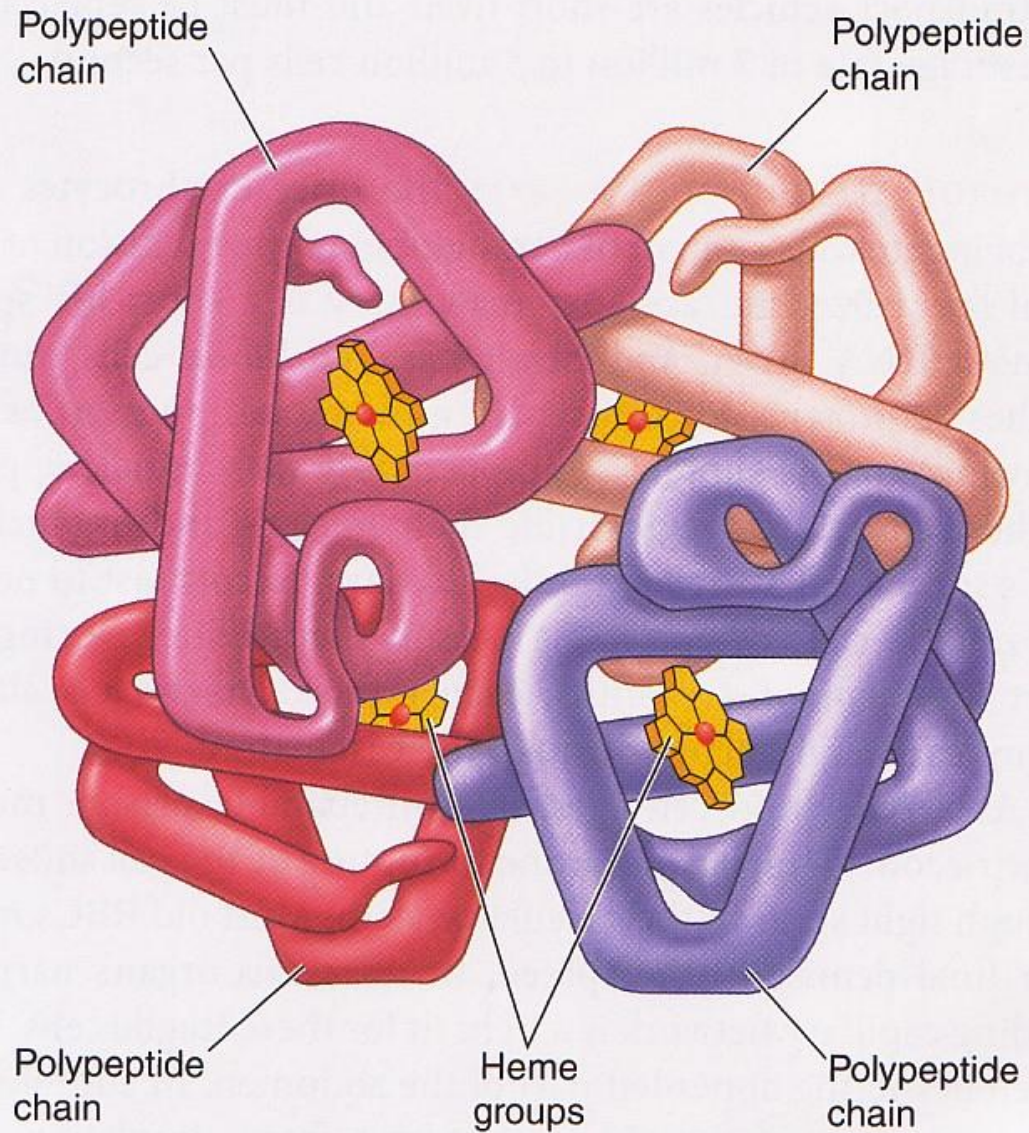


# Heme Structure



**NB:** CO carbon monoxide binds w/~200-fold > affinity than O<sub>2</sub>

# Hemoglobin Structure

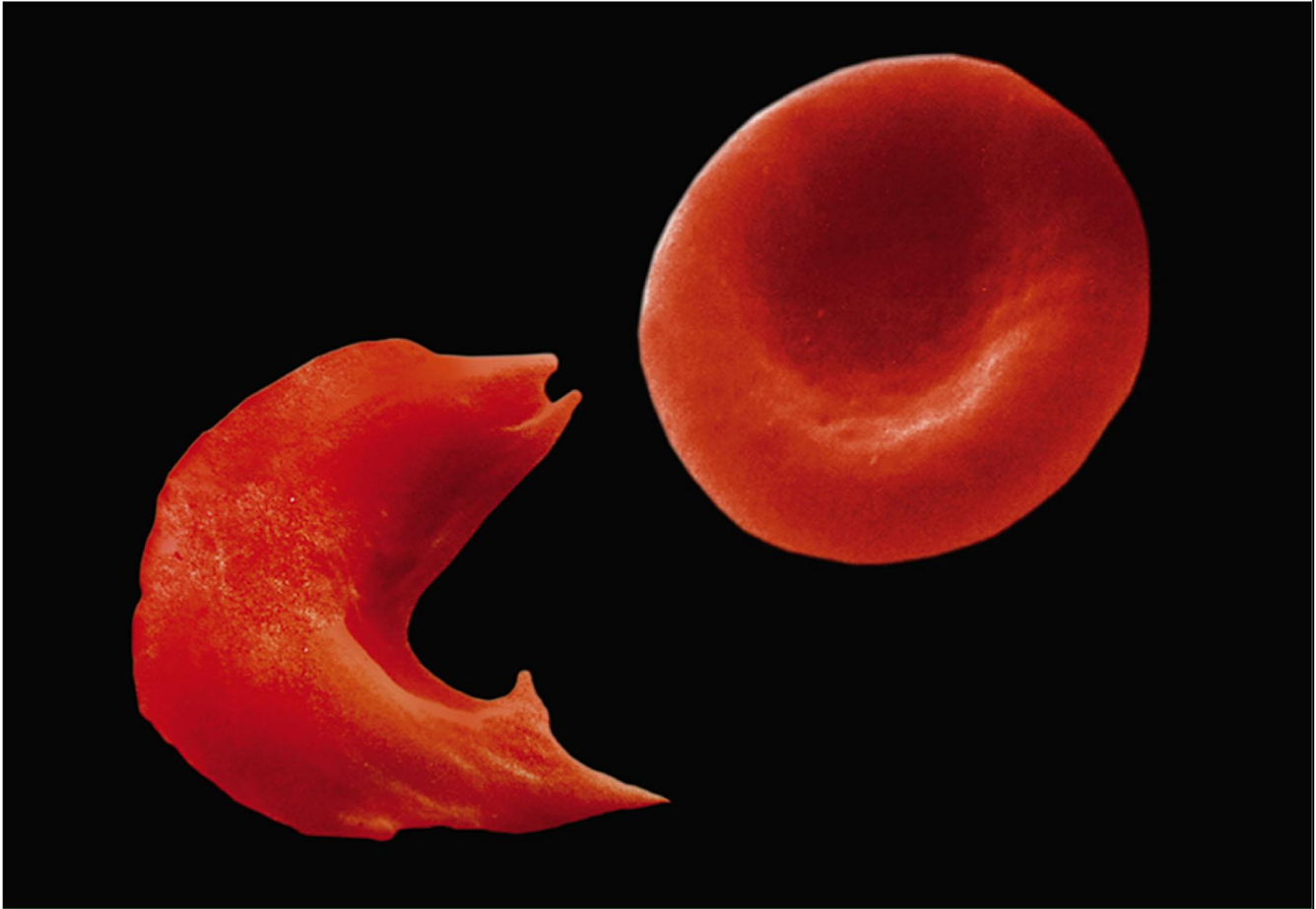




Sickle-shaped blood cells

Normal red blood cells

© Dr. Stanley Flegler/Visuals Unlimited



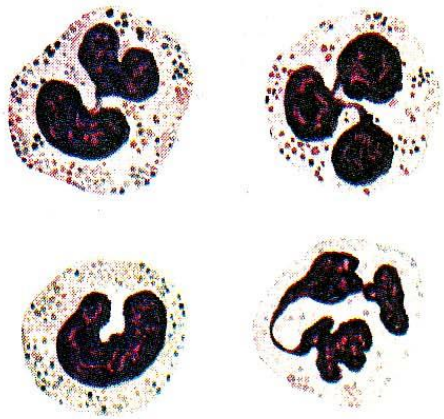
**What a difference one amino acid can make!**

Amino acid sequence of normal hemoglobin:

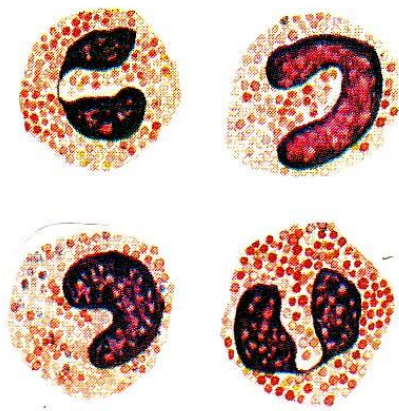


Amino acid sequence of sickle-cell hemoglobin:

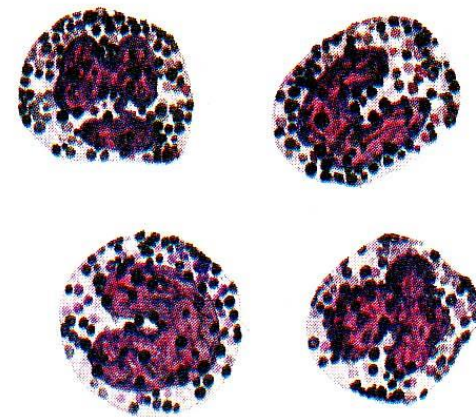




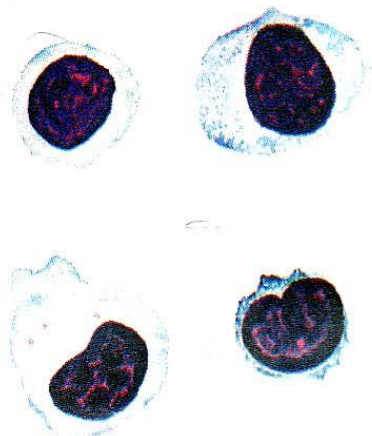
NEUTROPHILS



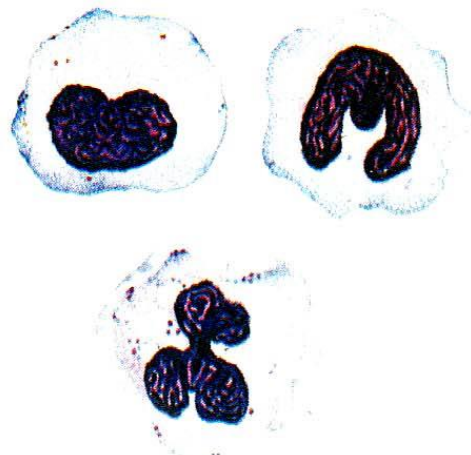
EOSINOPHILS



BASOPHILS



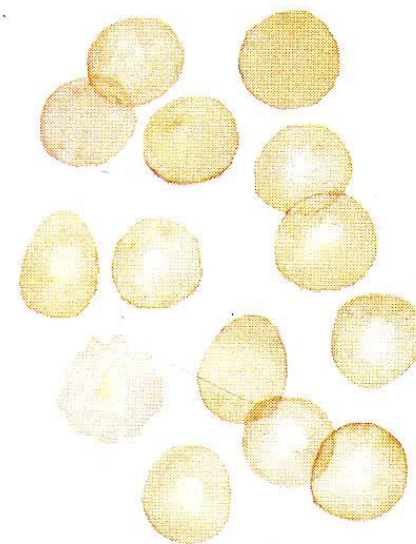
LYMPHOCYTES



MONOCYTES



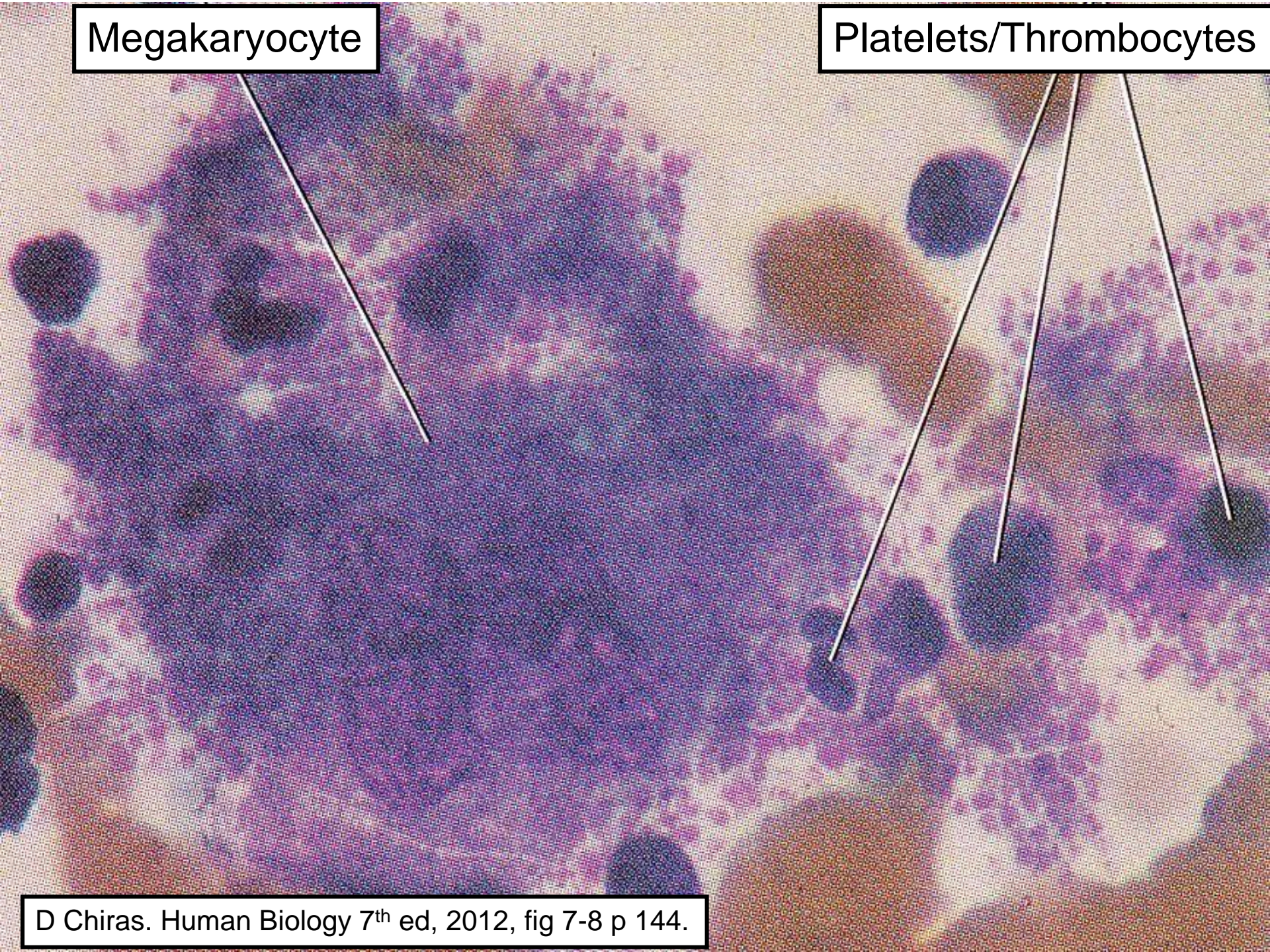
PLATELETS



ERYTHROCYTES

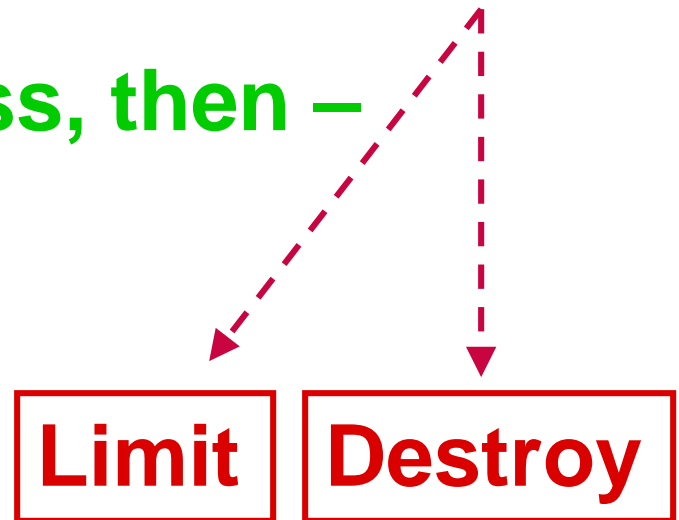
Megakaryocyte

Platelets/Thrombocytes



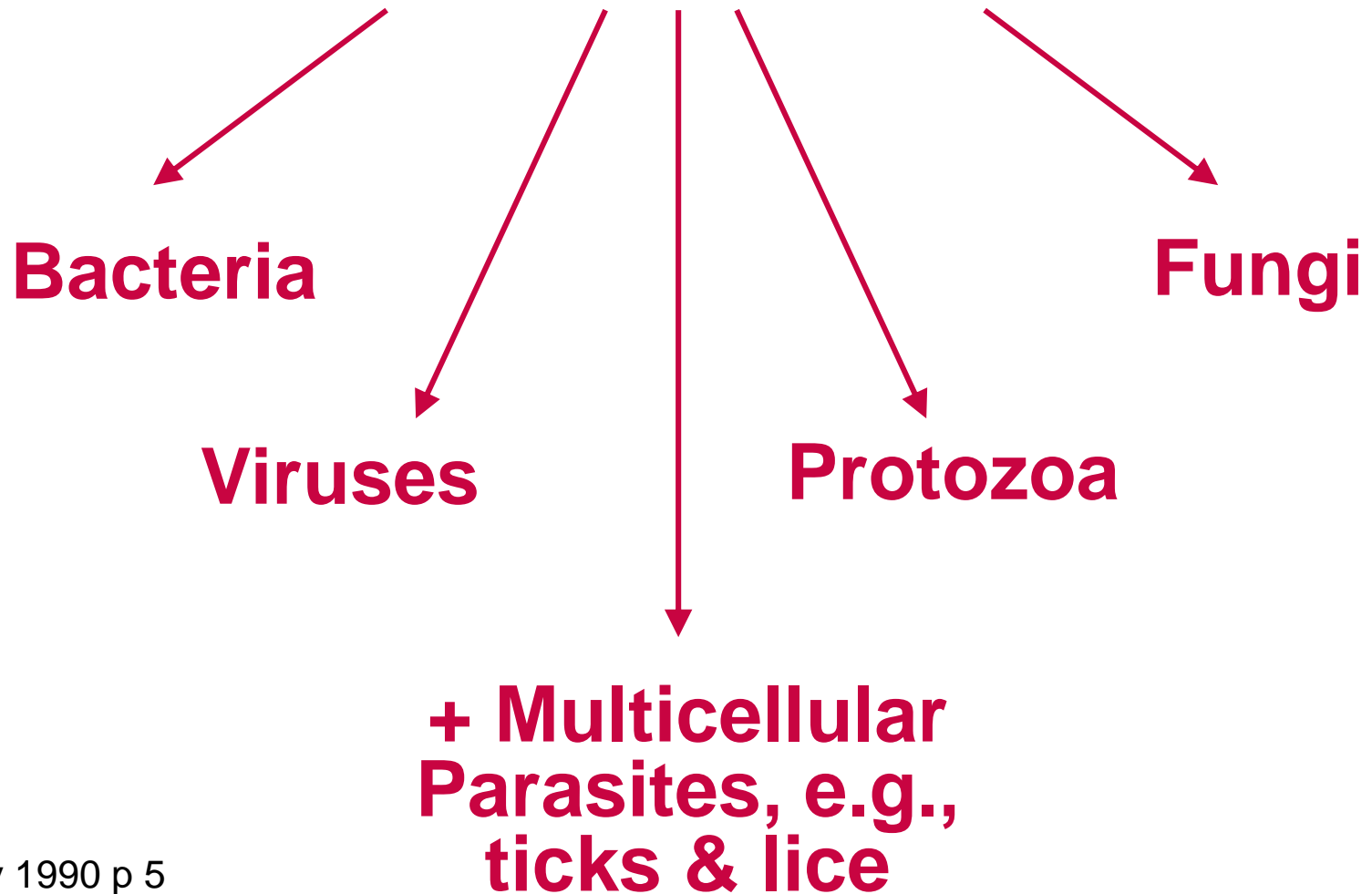
# *Immune Response*

1. Detect invader or ID toxic product.
2. Communicate to network.
3. Recruit coordinated, multi-pronged attack.
4. Amplify & if yes to success, then –
5. Suppress



# *Pathogen?*

## **Microbes that cause disease!**



# ***Pathogens & Parasites Cause:***

- 1. 70-80% of deaths in less developed countries**
- 2. Tens of millions of deaths due to infectious diseases**
- 3. > 20 million childhood deaths per year in Asia, Africa & Latin America due to diarrheal infections alone**
- 4. Yet < 2% deaths in modern, industrialized countries!**

***World Health Organization 2016 Statistics***

# *Why such striking differences across the world?*

1. **Poor sanitation**
2. **Contaminated water supply**
3. **Contaminated food supply**
4. **Malnutrition**
5. **Existing infections**
6. **Patchy, inadequately-funded vaccinations**
7. **AIDS superimposed on top of 1-6!**

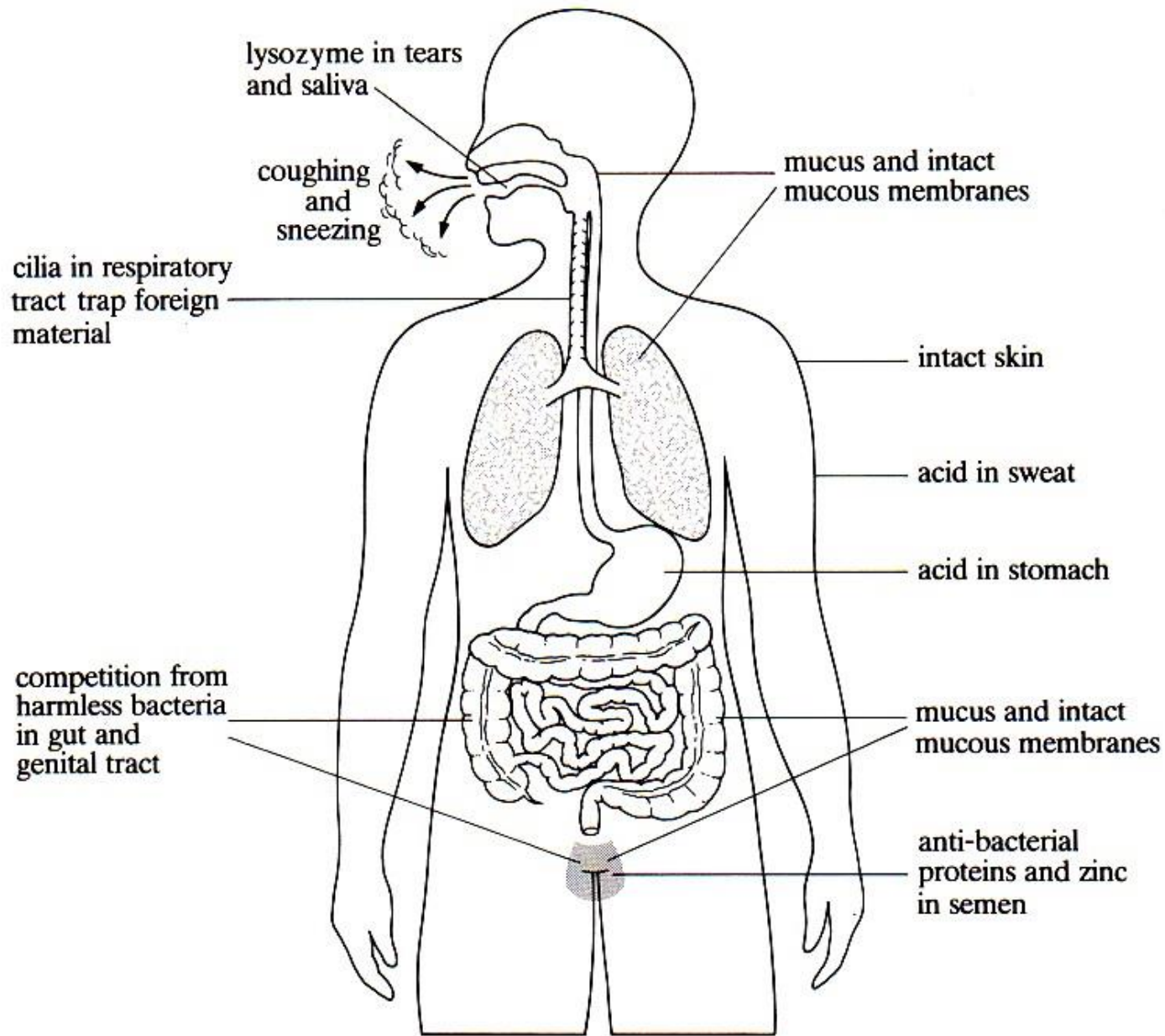
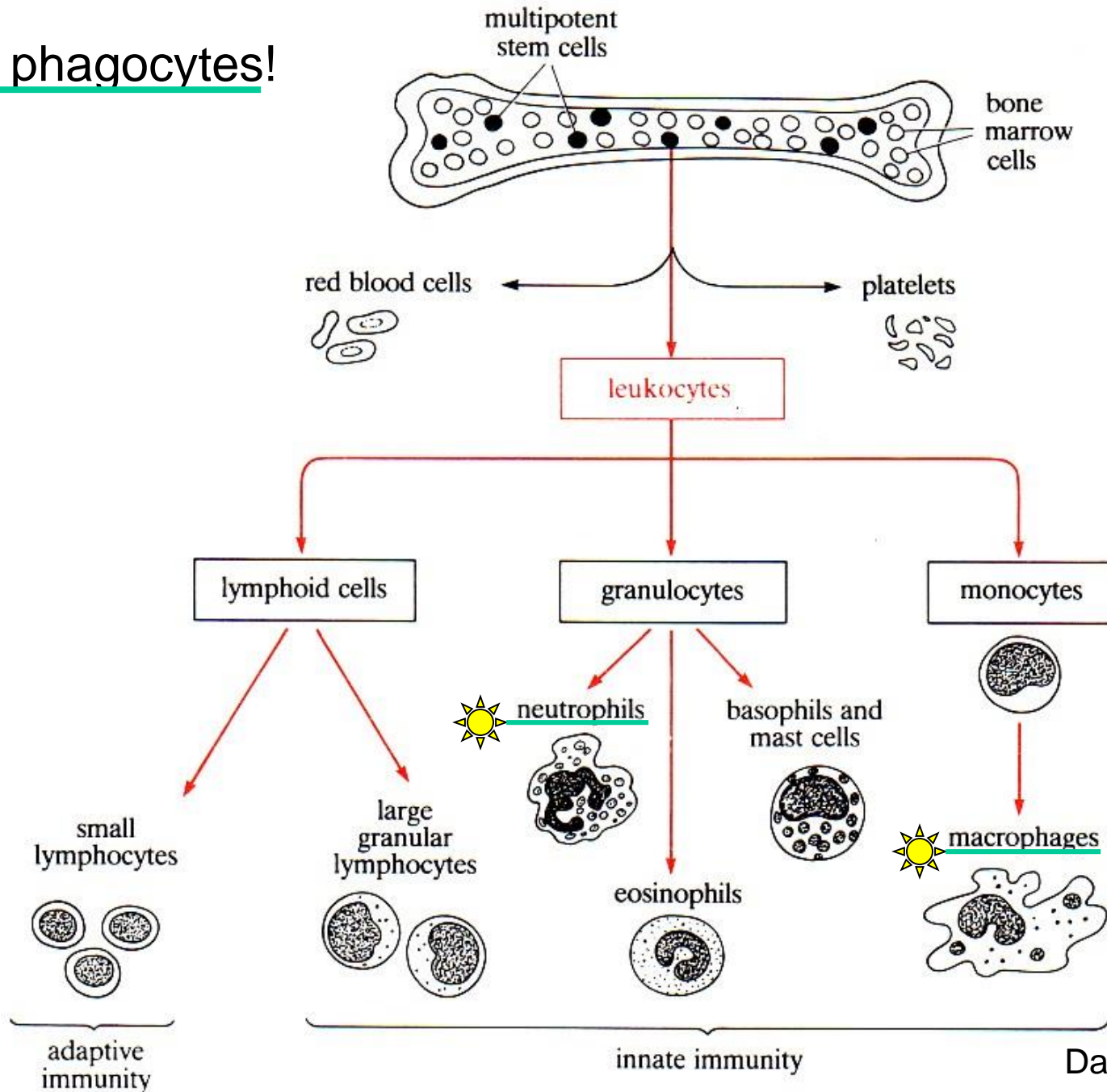
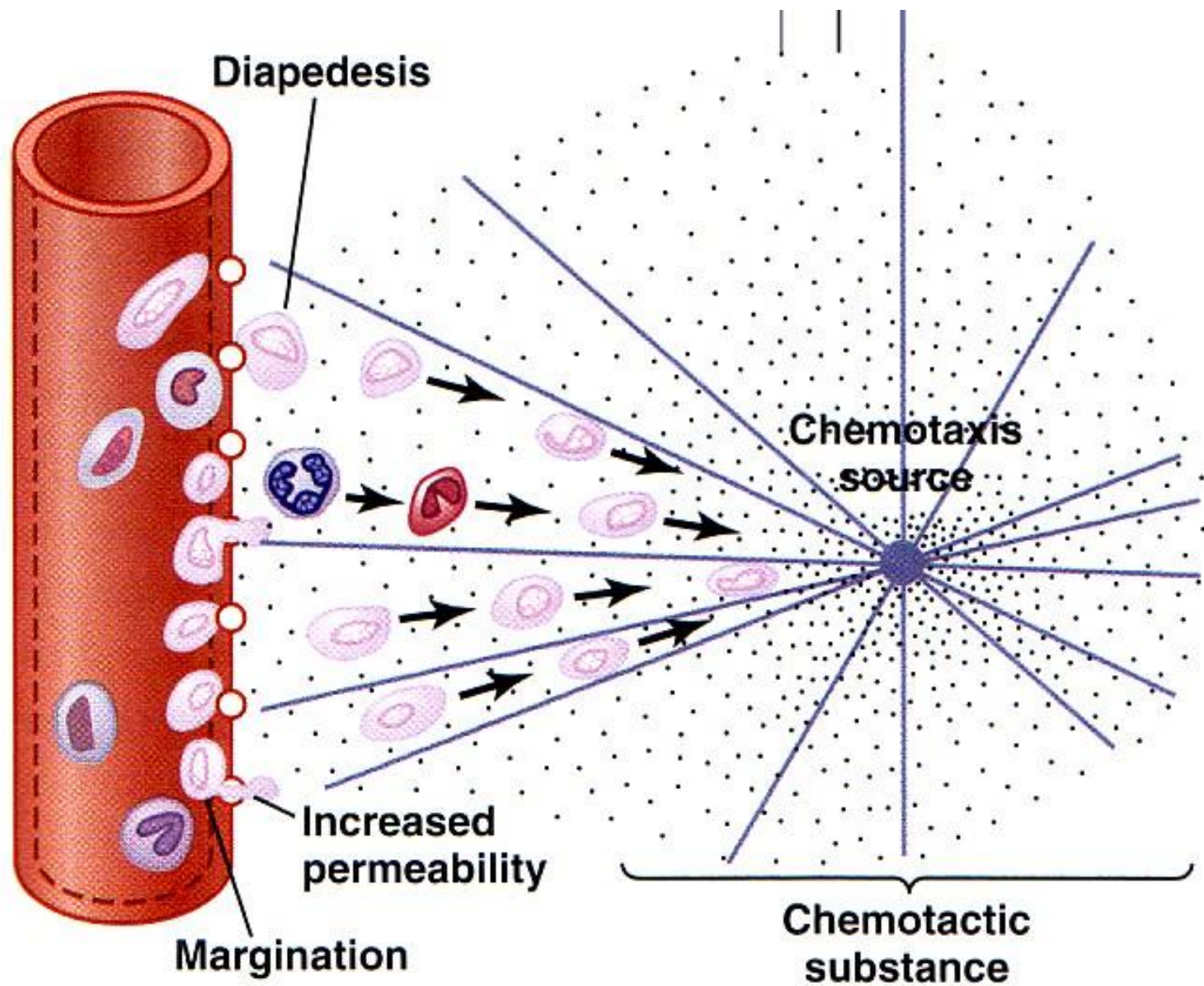


FIGURE 2.1 Summary of the main physical, chemical and mechanical barriers to infection entering the human body.

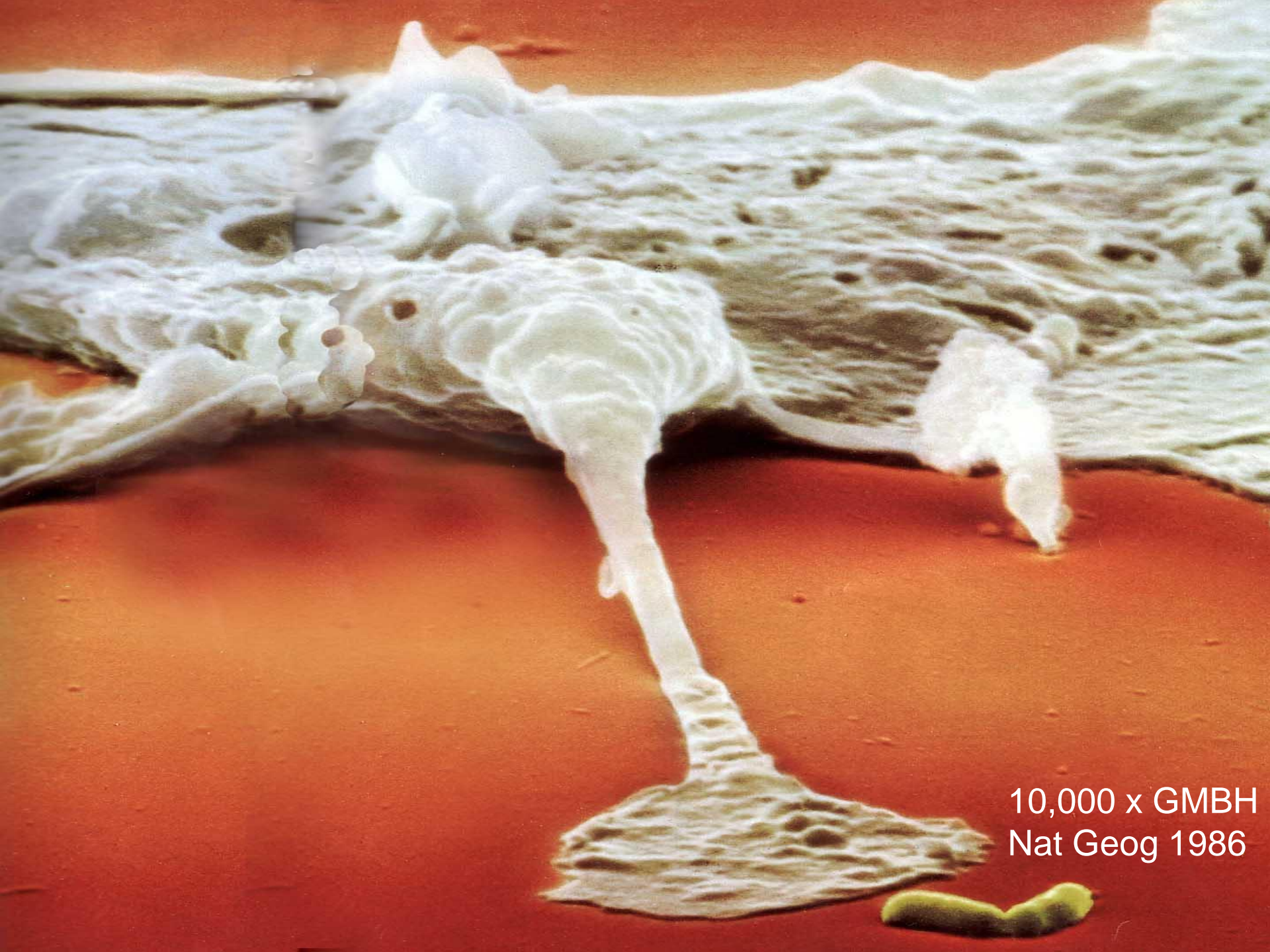


# Good phagocytes!

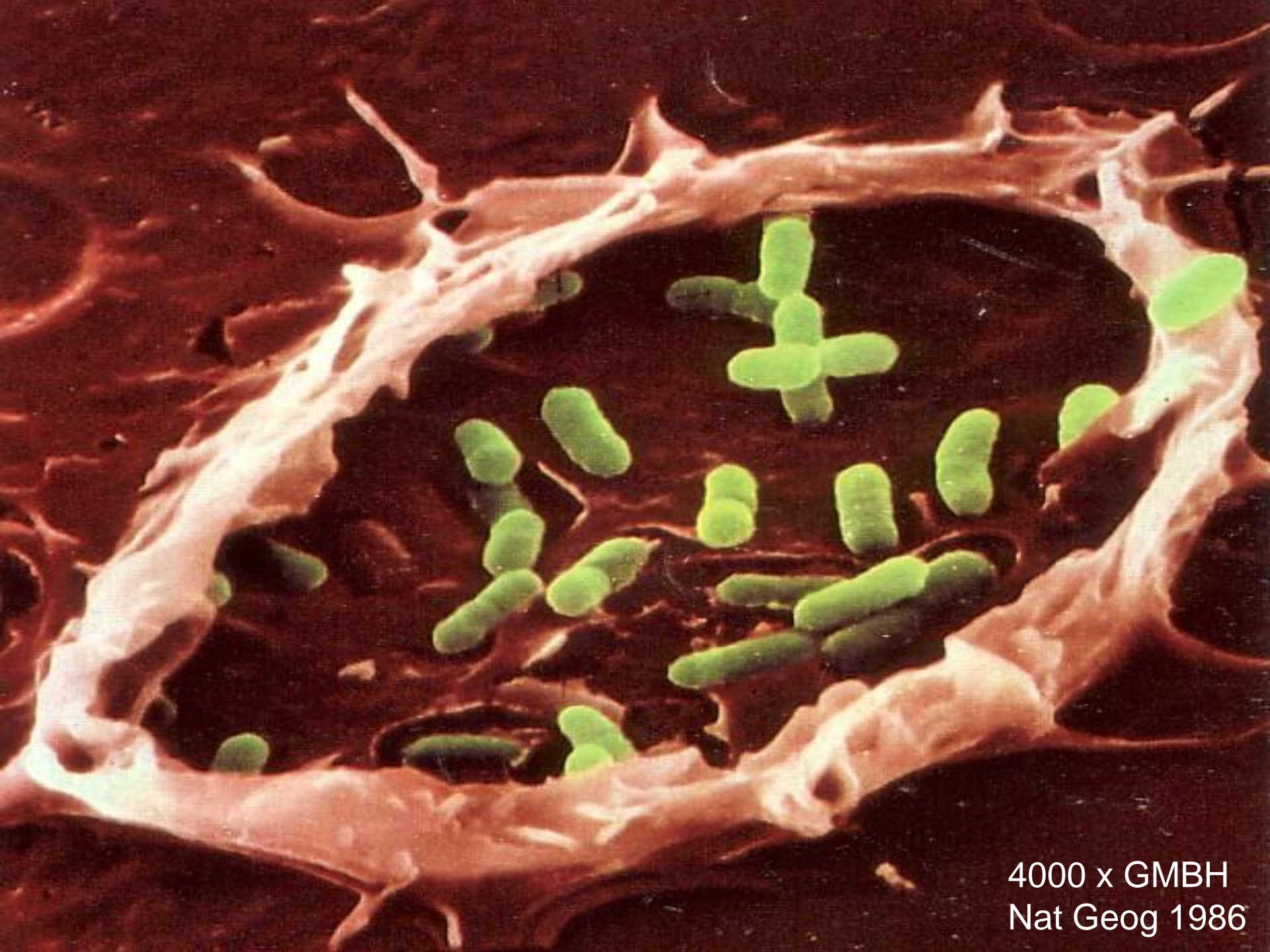




**Figure 33-2** Movement of neutrophils by *diapedesis* through capillary pores and by *chemotaxis* toward an area of tissue damage. G&H 2011



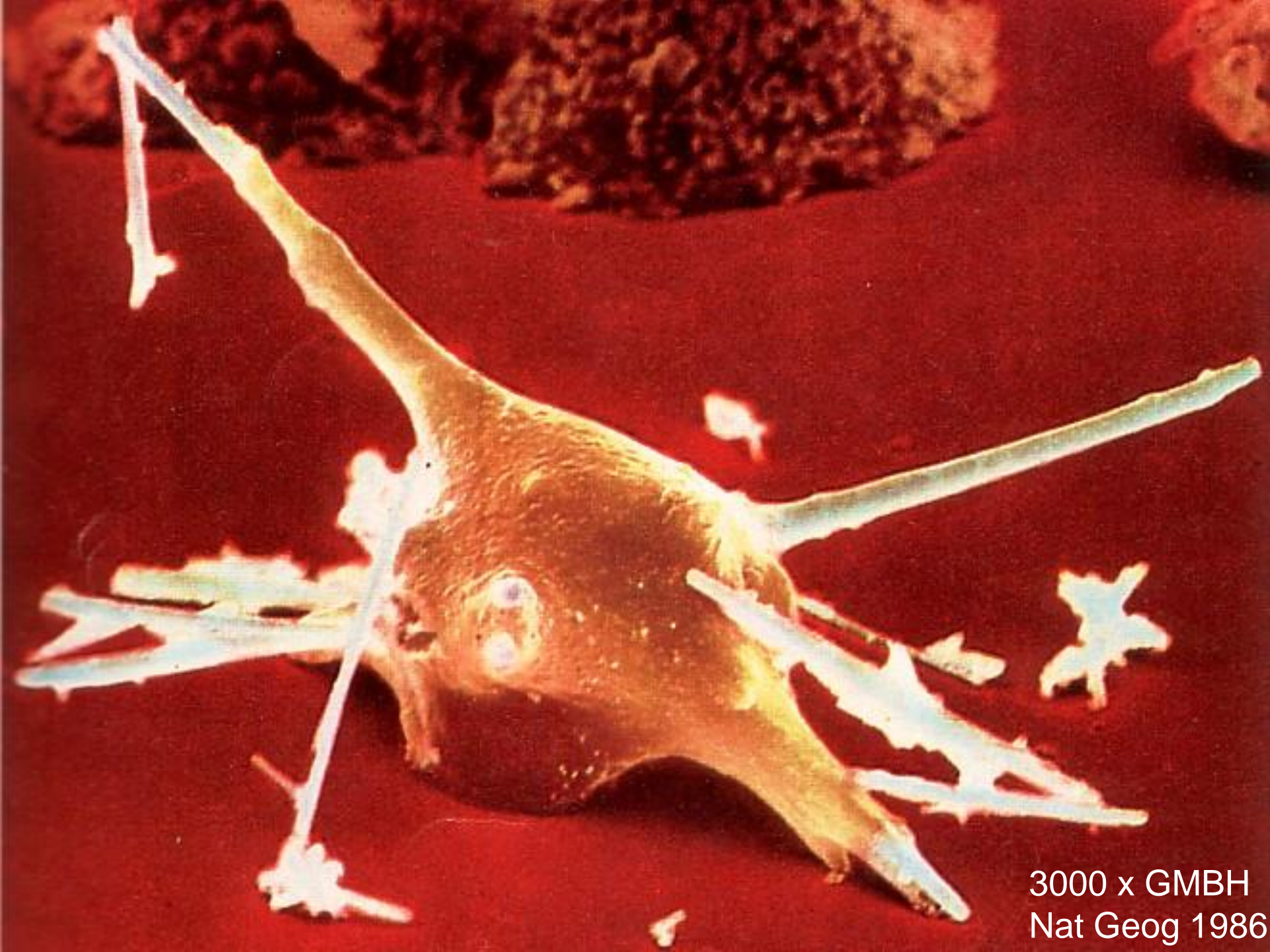
10,000 x GMBH  
Nat Geog 1986



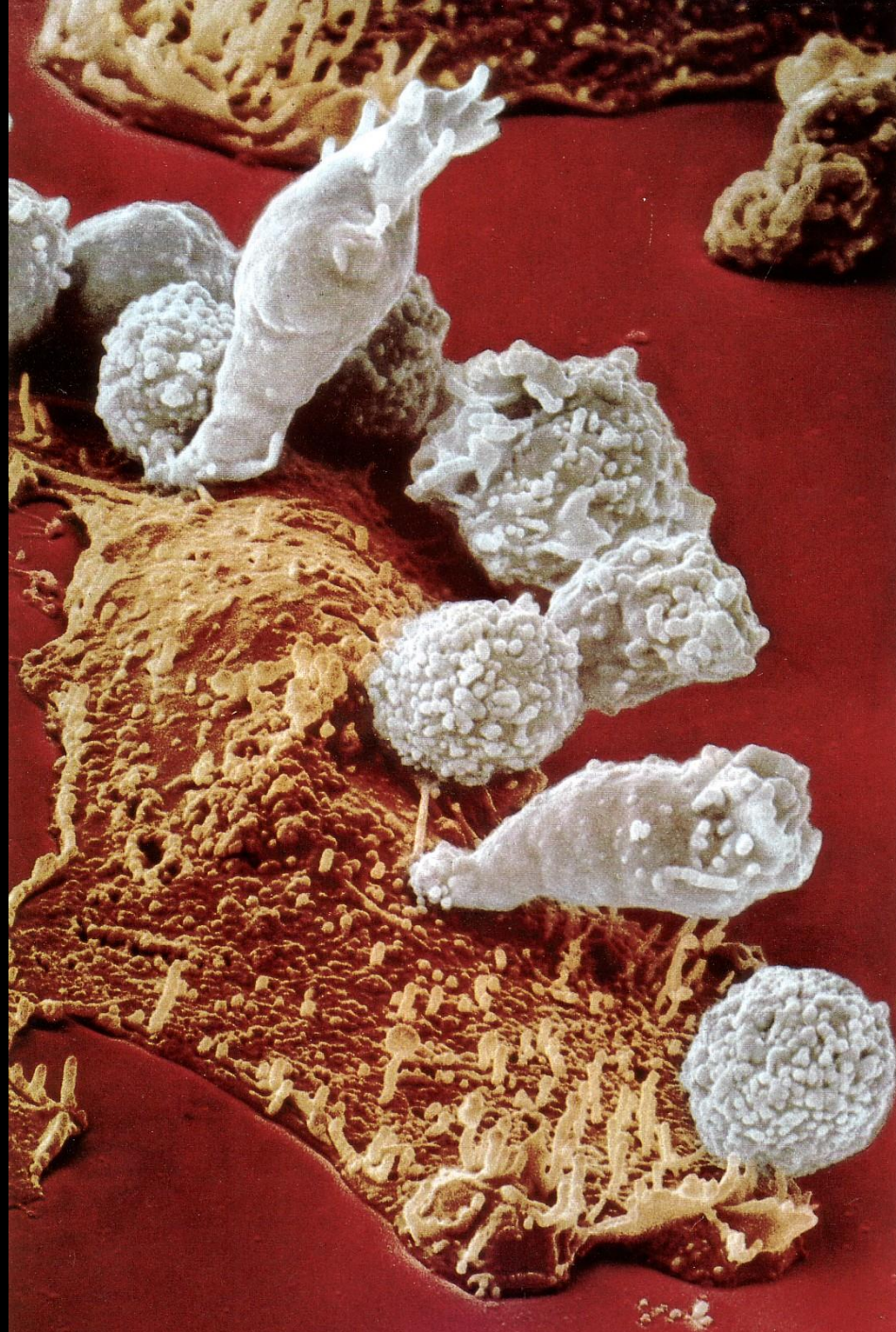
4000 x GMBH  
Nat Geog 1986



7000 x GMBH  
Nat Geog 1986



3000 x GMBH  
Nat Geog 1986



10,000 x GMBH  
Nat Geog 1986



7000 x GMBH  
Nat Geog 1986





# Hand-washing

**The right way to wash your hands:**

Thoroughly wash with soap and warm running water — rubbing your hands together for at least 10 seconds.

Hand-washing is the single most effective thing you can do to reduce the spread of colds and other infectious disease.

It's not necessary to use anti-bacterial soaps when washing up. Regular soap and water do the job just fine.

Also, using germicidal soaps too often may produce antibiotic-resistant bacteria.

*Source: Hospital Infections Program, U.S. Centers for Disease Control and Prevention*



**NB: Happy Birthday Song 20-30 sec!!**



**<http://www.squidsoap.com/>**