

BI 358 Lecture 6



...Gorgeous photos by Lennart Nilsson of Nova fame!
http://www.lennartnilsson.com/human_body.html

- I. **Announcements** Quiz 2 on Tuesday covers Lectures 4 & 5, GI Physiology & Nutrition. Discussion then white blood cell differential lab! Please read p 5-2 + articles sent by e-mail! Nutrition reports to Aleesa aleesas@uoregon.edu or Precious precious@uoregon.edu by 5 pm Tuesday. Outline update? Q?
- II. **Nutrition Connections** Why plant-based?...exercise?...coconut?
- 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
 - 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

Why More Fruits, Vegetables
Whole Grains & Beans?



Potential regulators
of health!

10s of thousands!

① Anti-oxidants
protect DNA from
oxidative damage

② Protein synthesis
regulation/control

③ Hormone-like
action
endocrine mimicry

④ Blood effects
modify blood chemistry



Phytochemicals ≡ Plant chemicals

aroma, color, taste

*Broccoli sprouts may contain
~ 10,000 unique phytochemicals!*





A Wealth of Phytochemicals

All cruciferous vegetables contain powerful cancer-fighting phytochemicals, including:

diindolylmethane (DIM), one of many *indoles* found in these vegetables, has been shown to inhibit proteins associated with breast and ovarian cancers.

crambene, plentiful in Brussels sprouts, may offer the most preventive benefits when combined with *indole-3-carbinol* (I3C).

glucosinolates, which turn into powerful protective agents called *isothiocyanates* when a cruciferous vegetable is chewed or chopped. May reduce inflammation, a factor in cancer development.



American Institute for Cancer Research

American Institute for Cancer Research

Foods that Fight Cancer

Beans fiber, saponins, protease inhibitors, phytic acid.

Berries fiber, vitamin C, ellagic acid, flavonoids

Cruciferous Vegetables glucosinolates: glucoraphin →
sulphoraphane, crambene, indole-3-carbinol & isothiocyanates

Dark Green Leafy Vegetables fiber, folate, carotenoids: 1^o lutein &
zeaxanthin; saponins, flavonoids

Flaxseed lignans (a phyto-E), α -linolenic acid (an Ω -3)

Garlic organosulfurs: allicin, alliin, allyl sulfides; quercetin,...

Grapes and Grape Juice resveratrol (a polyphenol)

Green Tea catechins (class of flavonoids), polyphenols

Soy isoflavones, saponins, phenolic acids, phytic acid, phytosterols,
protein kinase inhibitors

Tomatoes lycopene

Whole Grain fiber, vitamins, minerals, 100s of phytochemicals:
antioxidants, phenols, lignans (a phyto-E), saponins

http://www.aicr.org/site/PageServer?pagename=foodsthatfightcancer_home

≥ 5 tomato-containing meals per week may protect from cancers of the esophagus, stomach & prostate !



...but, the phytochemical candidate, lycopene with anti-oxidant activity is also in guava, papaya, pink grapefruit & watermelon!





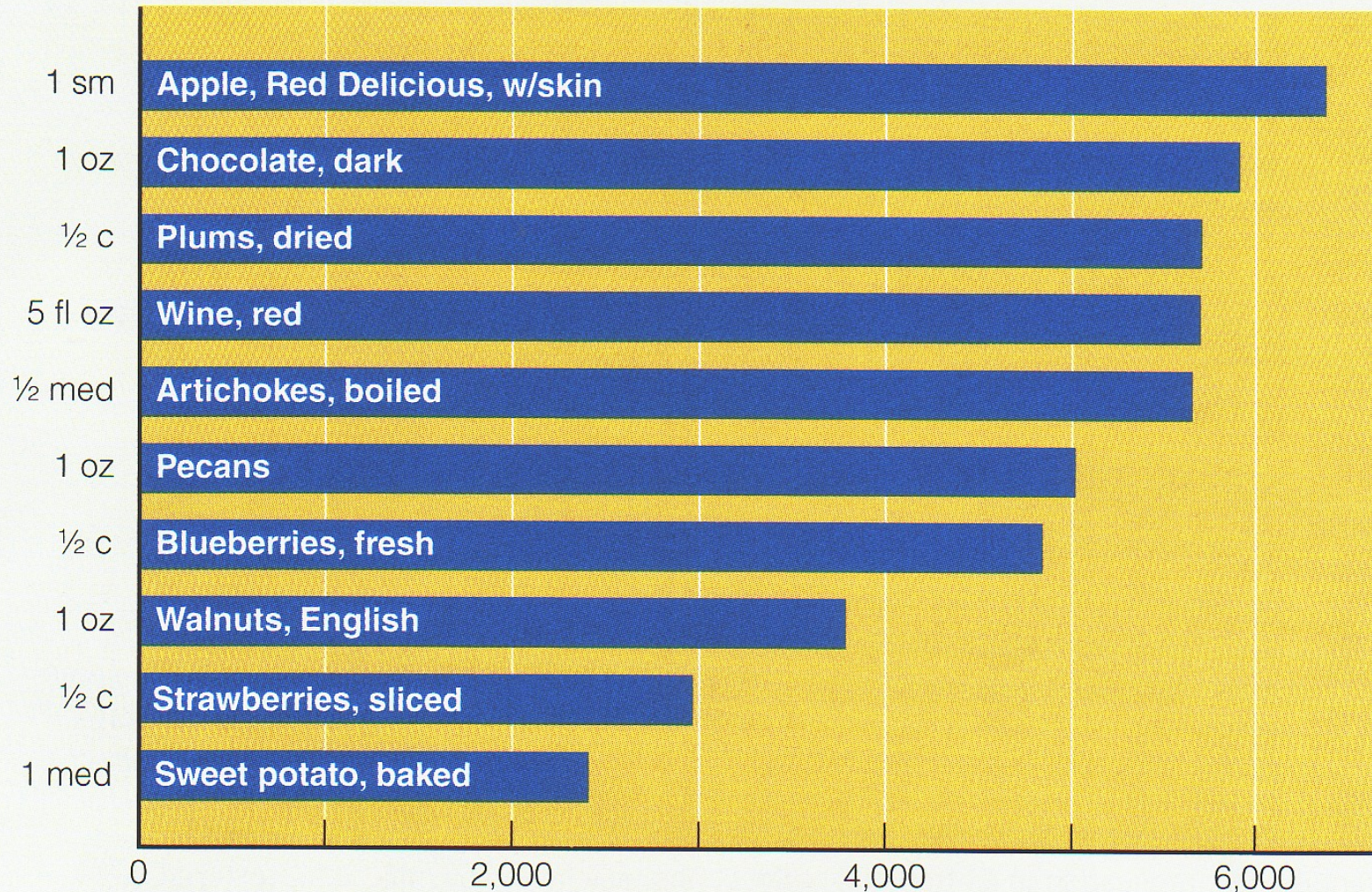
TABLE
C2-3

Common Foods Ranked by Antioxidant Content

1. Blackberries
2. Walnuts
3. Strawberries
4. Spinach
5. Artichokes, prepared
6. Cranberries
7. Coffee
8. Raspberries
9. Pecans
10. Blueberries
11. Cloves, ground
12. Grape juice, cranberry juice,
pomegranate juice
13. Chocolate, dark, unsweetened
14. Cherries, sour
15. Wine, red



Antioxidant Capacity Depends Upon Seasons, Storage, Testing Methods, Variety...



^aMeasured in micromole TE (Trolox equivalents), a laboratory-derived value used to measure the antioxidant activity of foods. Other laboratory methods yield other results.

Source: R. M. Bliss, Data on Food Antioxidants Aid Research, November 2007, available at <http://www.ars.usda.gov/is/pr/2007/071106.htm>.

Environmental Working Group Suggestions

12 Most Contaminated

Buy These Organic



• Apples



• Bell Peppers



• Celery



• Cherries



• Imported Grapes

• Nectarines



• Peaches



• Pears

• Potatoes



• Red Raspberries



• Spinach



• Strawberries



12 Least Contaminated

Not as Much Concern

- Asparagus
- Avocados
- Bananas
- Broccoli
- Cauliflower
- Corn (sweet)
- Kiwi
- Mangos
- Onions
- Papaya
- Pineapples
- Peas (sweet)

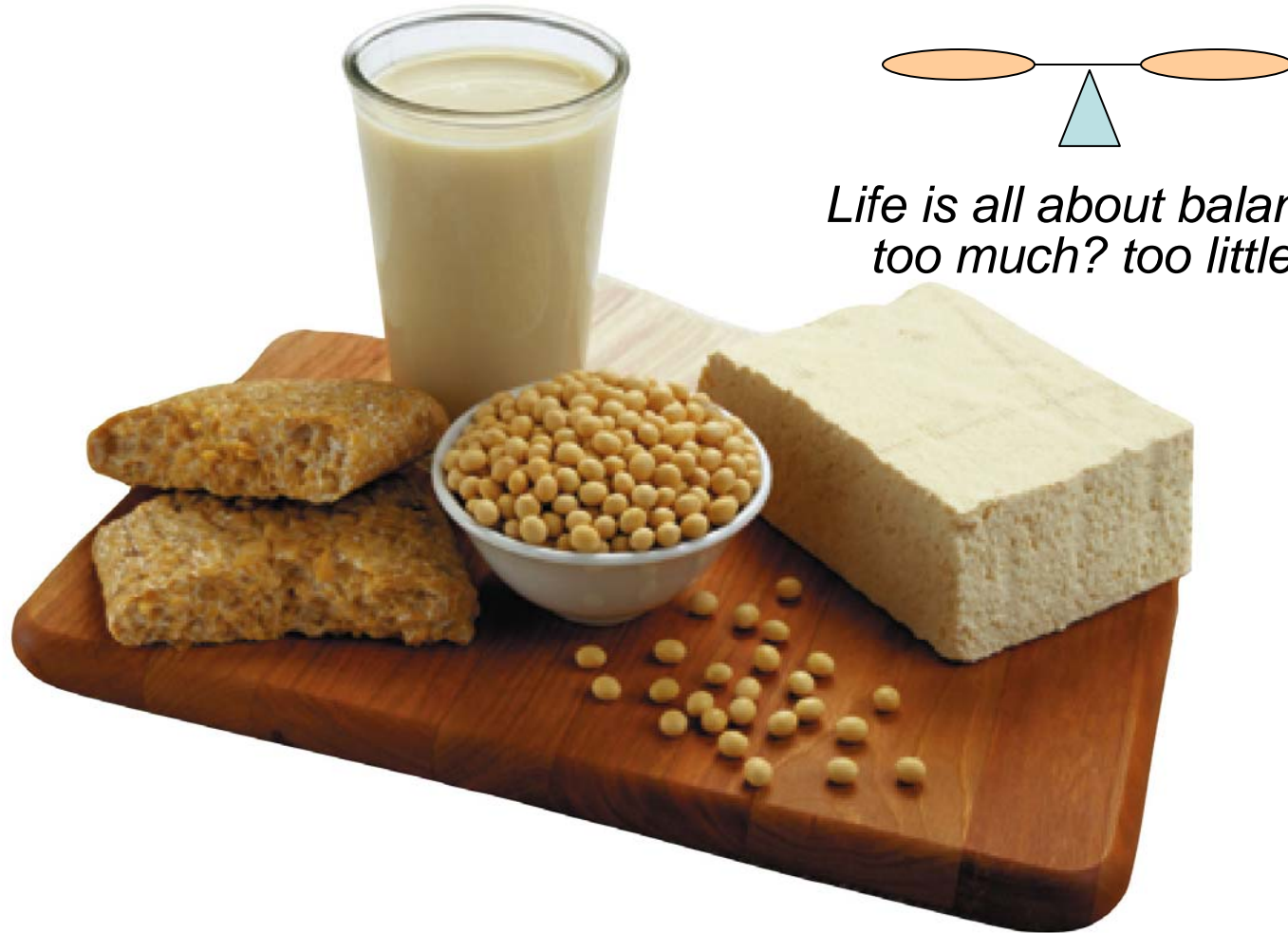
<http://www.foodnews.org/reportcard.php>



Resveratrol, a flavonoid in purple grape juice & red wine may lower incidence of cardiovascular diseases.

NB: ...but typical serving amounts may be too small to benefit human health!...Alcoholism?

*High doses of soy phytoestrogens may
lower blood cholesterol*

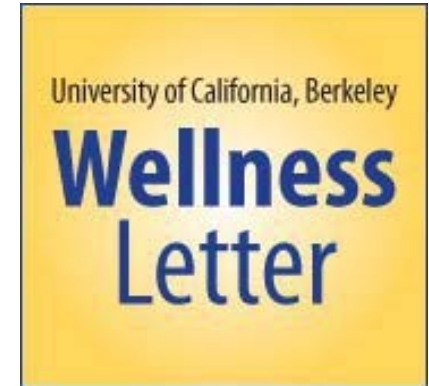


*Life is all about balance:
too much? too little?*

NB: ...but low doses of the phytoestrogen,
genistein promotes breast cancer cell
division (in lab cultures & mice).

Preventing Cancer: Strategies That Can Reduce Your Risk ***UC Berkeley Wellness Reports, 2012***

- 1. Don't smoke or use any tobacco product.**
- 2. Keep the weight off.**
- 3. Get off the couch.**
- 4. Eat a healthy diet.**
- 5. Drink less alcohol.**
- 6. Limit high-heat cooking.**
- 7. Limit sun exposure.**
- 8. Limit radiation from medical imaging tests.**
- 9. Test your home for radon.**
- 10. Test your water for arsenic.**
- 11. Decrease workplace exposure to carcinogens.**
- 12. Limit your exposure to air pollution (outdoors & indoors).**





Diet & Lifestyle Recommendations

- 1. Use up at least as many calories as you take in!***
- 2. Eat a variety of nutritious foods from all food groups.***
- 3. Eat less of the nutrient-poor foods.***
- 4. Don't smoke tobacco — and stay away from tobacco smoke.***

[http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Dictionary-of-Nutrition UCM 305855 Article.jsp](http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Dictionary-of-Nutrition_UCM_305855_Article.jsp)



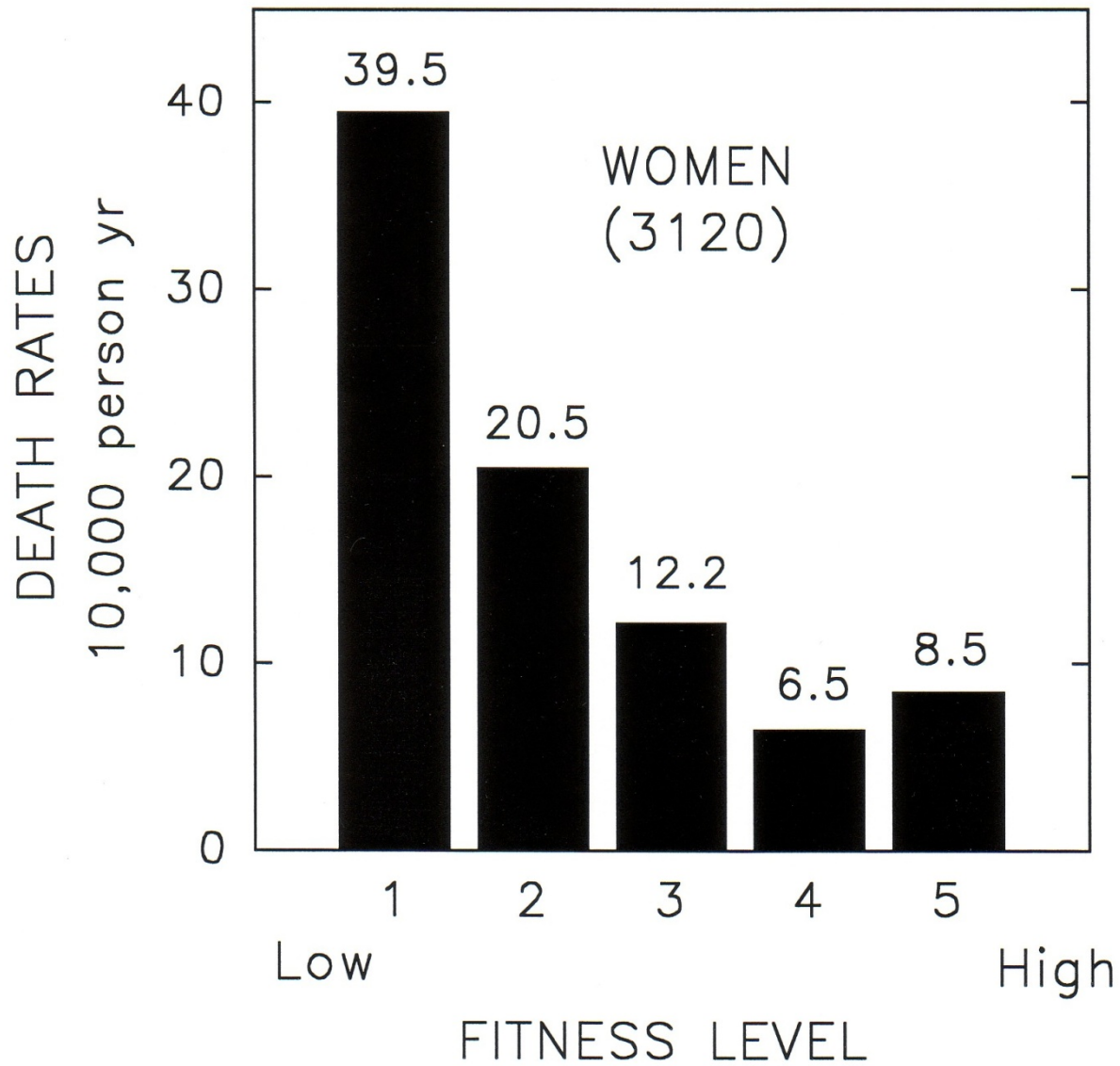
Daily Food Choice Recommendations

1. Choose lean meats & poultry without skin & prepare them without added saturated & trans fat.
2. Select fat-free, 1 percent fat & low-fat dairy products.
3. Cut back on foods containing partially hydrogenated vegetable oils to reduce trans fat.
4. Cut back on foods high in dietary cholesterol. Aim to eat less than 300 milligrams of cholesterol each day.
5. Cut back on beverages and foods with added sugars.
6. Choose and prepare foods with little or no salt. Aim to eat less than 1,500 milligrams of sodium per day.
7. If you drink alcohol, drink in moderation. 1 drink/day if you're a woman & 2 drinks/day if you're a man.
8. Follow AHA recommendations when you eat out & keep an eye on portion sizes.

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



**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>

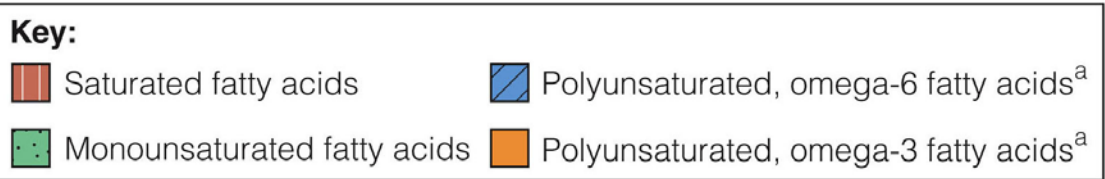
<http://www.acsm.org/access-public-information/brochures-fact-sheets/fact-sheets>

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

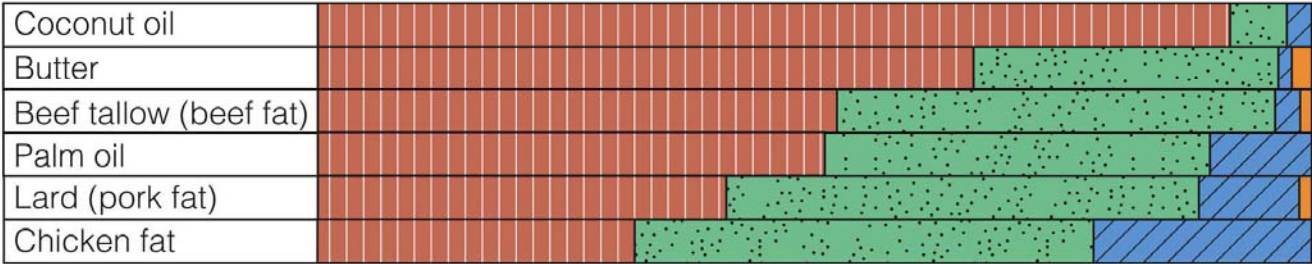


Adults: Moderate to Vigorous Exercise \geq 30 min, 5 d/wk

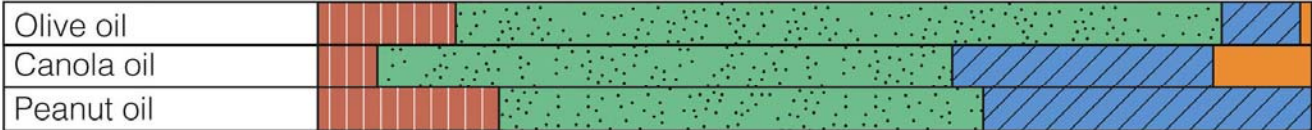
Children: Moderate to Vigorous Exercise \geq 60 min, 5 d/wk



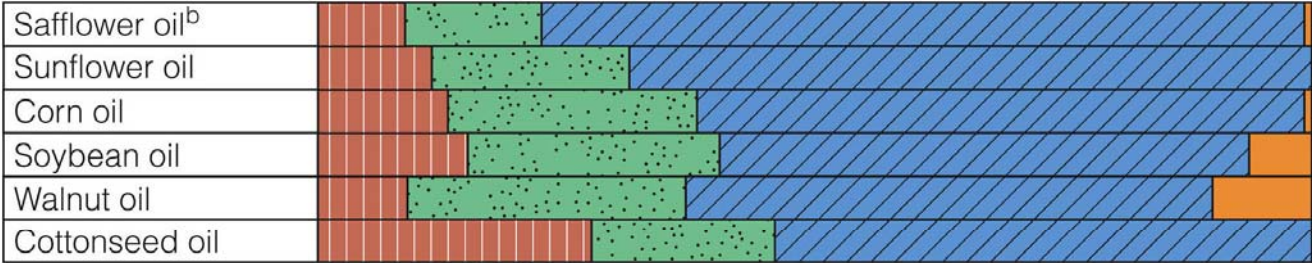
Animal fats and the tropical oils of coconut and palm contain mostly saturated fatty acids.



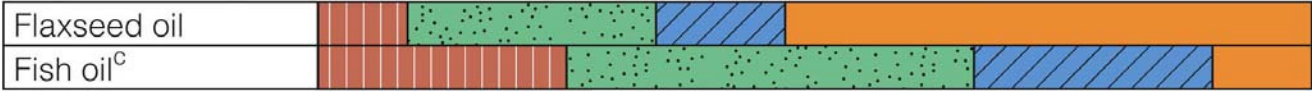
Some vegetable oils, such as olive and canola, are rich in monounsaturated fatty acids.



Many vegetable oils are rich in omega-6 polyunsaturated fatty acids.^a



Only a few oils provide significant omega-3 polyunsaturated fatty acids.^a



^aThese families of polyunsaturated fatty acids are explained in a later section.

^bSalad or cooking type over 70% linoleic acid.

^cFish oil average values derived from USDA data for salmon, sardine, and herring oils.



The Amazing BENEFITS Coconut^{of} Oil

Nutritional Content in Coconut Oil:

Anti
oxidants

MCT
Medium-Chain
Triglycerides

Lauric
Acid

Caprylic
Acid

Capric
Acid

The Health & Healing Benefits of Coconut Oil:

Skin Care

The **MCT** in Coconut oil act as a natural skin conditioner. Deeply penetrating & moisturizing, they protect against environmental & free radical damage. It also helps with anti-aging, eczema & even provides some sun protection.

Hair Care

Coconut oil is one of the best ways to provide nutrients to your hair. The fatty acids condition deeply from the insides of the strands out. Providing protein, eliminating dandruff & aiding in re-growth. Many people use it as a conditioner!

Stress Relief

Coconut oil is very soothing. The natural aroma of coconut is also very soothing. You can apply the oil to your head & gently massage to help remove mental fatigue.

Weight Loss

The Fatty Acids in coconut oil destroy candida, (yeast overgrowth) which triggers weight gain, carbohydrate cravings & fatigue. They're easily digested & converted into energy, which helps to speed up metabolism & help burn stored fat.

Immunity

The unique saturated fats of coconut oil contain antibacterial, antiviral, anti-fungal, and anti-parasitic properties that help strengthen the immune system. Consuming coconut oil regularly will reduce incidences of sickness.

Infections

Lauric Acid (found only in breast milk & coconut oil) is converted into monolaurin in the body. This may destroy bacterial & viral infections like measles, influenza, hepatitis C & even HIV. Monolaurin may also eliminate Athlete's foot.

Digestion

MCT molecules in coconut oil are small so they are easily digested with less strain on the pancreas & digestive system. People suffering from diabetes, obesity, gallbladder disease, or Crohn's disease may benefit greatly from coconut oil.

Diabetes

Coconut oil may improve insulin sensitivity & glucose tolerance over time. It helps regulate blood sugar levels & protects against insulin resistance. It can even help prevent Type II Diabetes.

Heart Health

The fat in coconut oil does **not** have a negative effect on cholesterol. In fact, it helps improve your cholesterol profile. It helps prevent heart attack & stroke and may even cure heart disease.

TIP: Buy Organic, Unrefined, Cold-Pressed, Extra-Virgin Coconut Oil!



SOURCES:

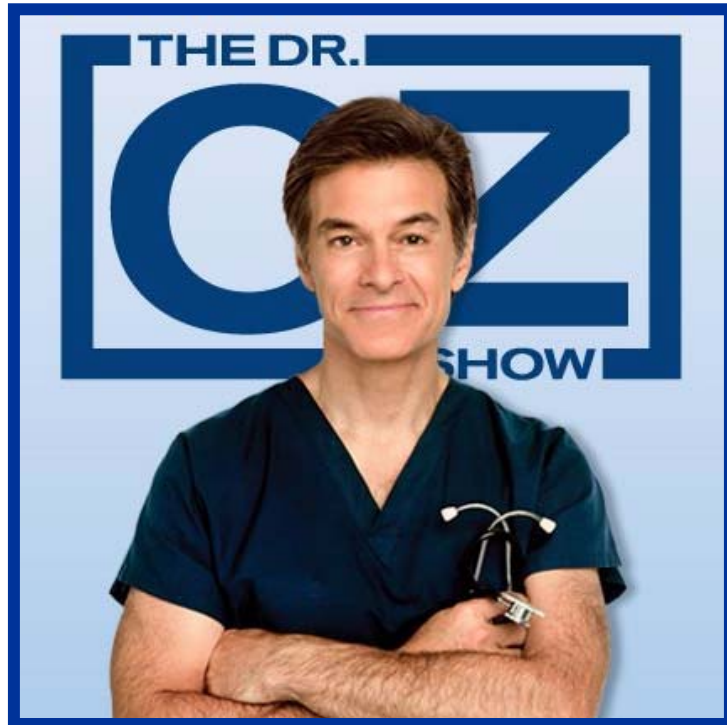
<http://www.coconutresearchcenter.org>

<http://http://www.organicfacts.net>

<http://www.naturalnews.com>

www.NaturalHealthyConcepts.com

Many claims with little scientific, peer-reviewed, research support



[http://www.doctoroz.com/
videos/surprising-health-
benefits-coconut-oil](http://www.doctoroz.com/videos/surprising-health-benefits-coconut-oil)

Coconut Oil Health Benefits

- 
- A graphic featuring a coconut and a slice of coconut. The coconut is cracked open, showing the white flesh and the brown husk. The slice is placed next to it. The background is a light green color with palm fronds. The text is arranged in a list format around the coconut.
- Improves or Reverses Alzheimer's Disease
 - Improves Type 2 AND Type 1 Diabetes
 - Improves or Heals Many Skin Diseases
 - Fungal Infections
 - Acne
 - Eczema
 - Keratitis Polaris
 - Psoriasis
 - Rosacea
 - Provides Peak Performance Energy
 - Drug-free Energy
 - Longer Endurance
 - Kills Candida Fungus
 - Helps with Hypothyroidism
 - Increases Metabolism
 - Raises Body Temperature
 - Conditions and Strengthens Hair
 - Penetrates Roots
 - Kills Lice
 - Improves Dandruff
 - Kills many Bacteria AND Viruses
 - Promotes Weight Loss
 - Preserves Muscle Mass
 - Promotes Ketosis

Find all the research at: CoconutOil.com



Coconut Oil Nutritional Wonder?

Claims?

<http://coconutoil.com/about-us/>

Review articles, last 5 yr (1) on health benefits?

<http://www.ncbi.nlm.nih.gov/pubmed/?term=coconut+oil+health+benefits>

Other articles?

<http://www.ncbi.nlm.nih.gov/pubmed/10948851>

<http://www.ncbi.nlm.nih.gov/pubmed/22260106>

The bottom line?

<http://www.cspinet.org/nah/articles/coconut-oil.html>

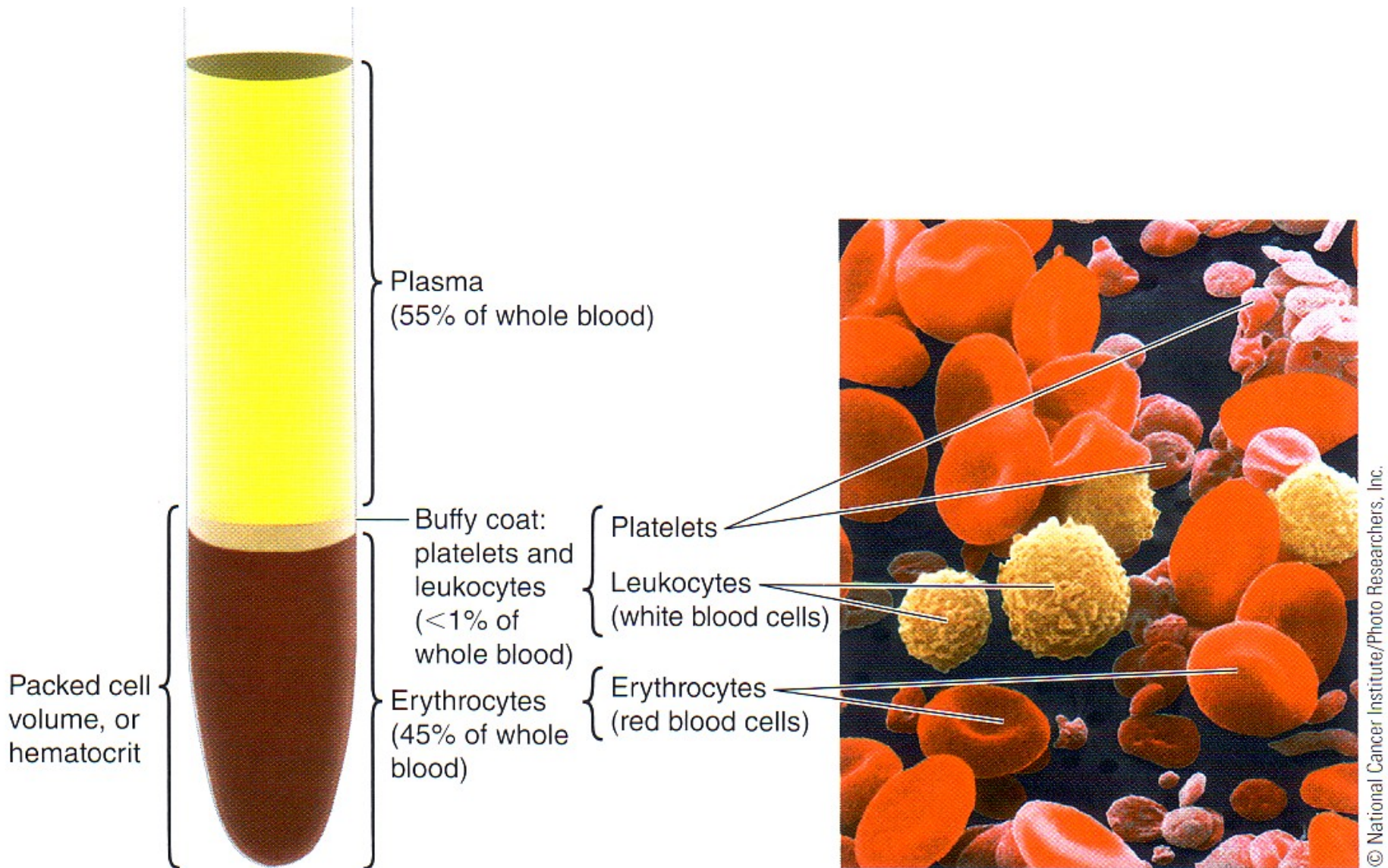
http://www.health.harvard.edu/newsletters/Harvard_Health_Letter/2011/May/coconut-oil

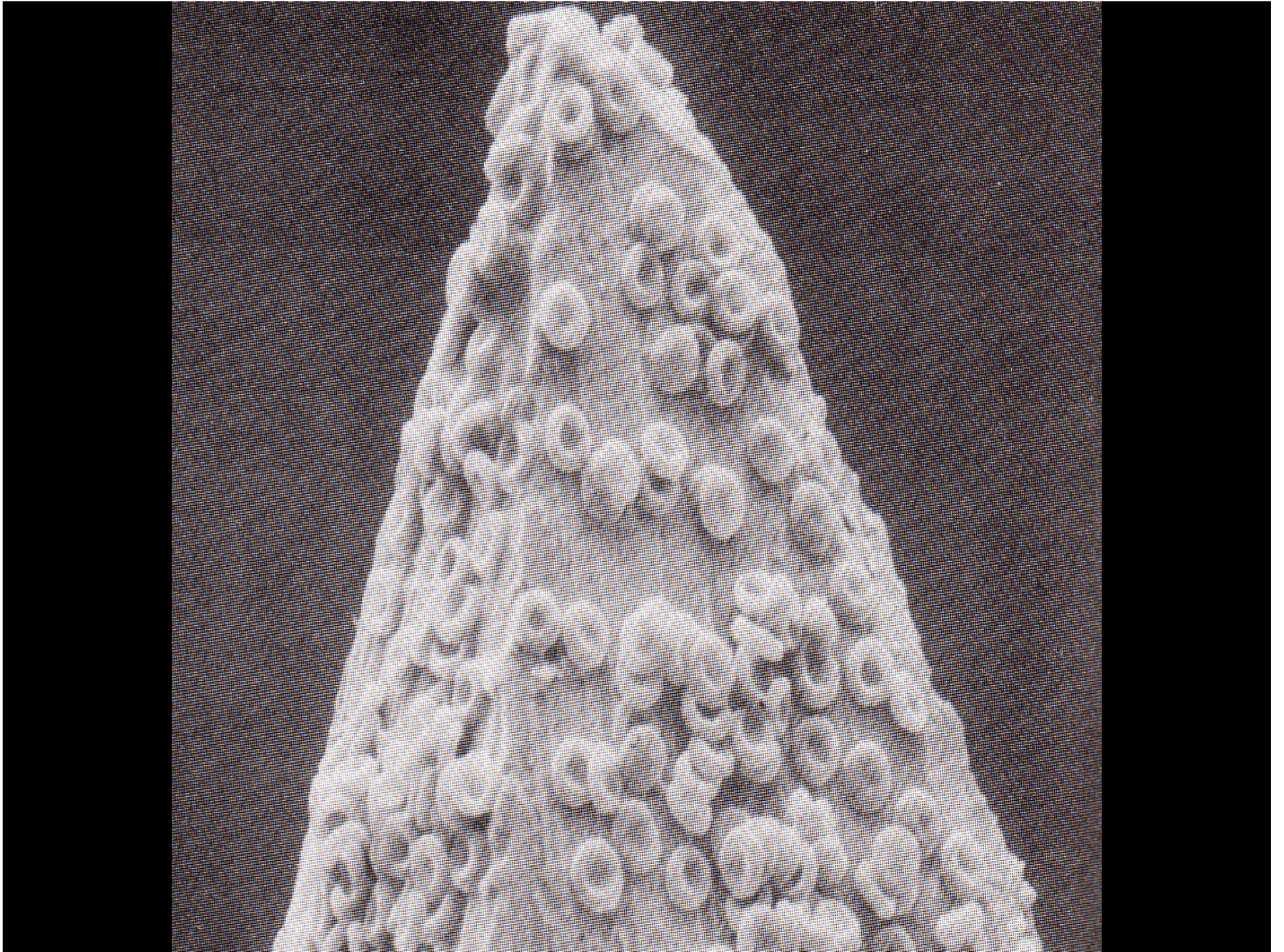
<http://health.clevelandclinic.org/2012/05/heart-healthy-cooking-oils-101/>

http://en.wikipedia.org/wiki/Smoke_point



What's in Blood? Plasma & Blood Cells

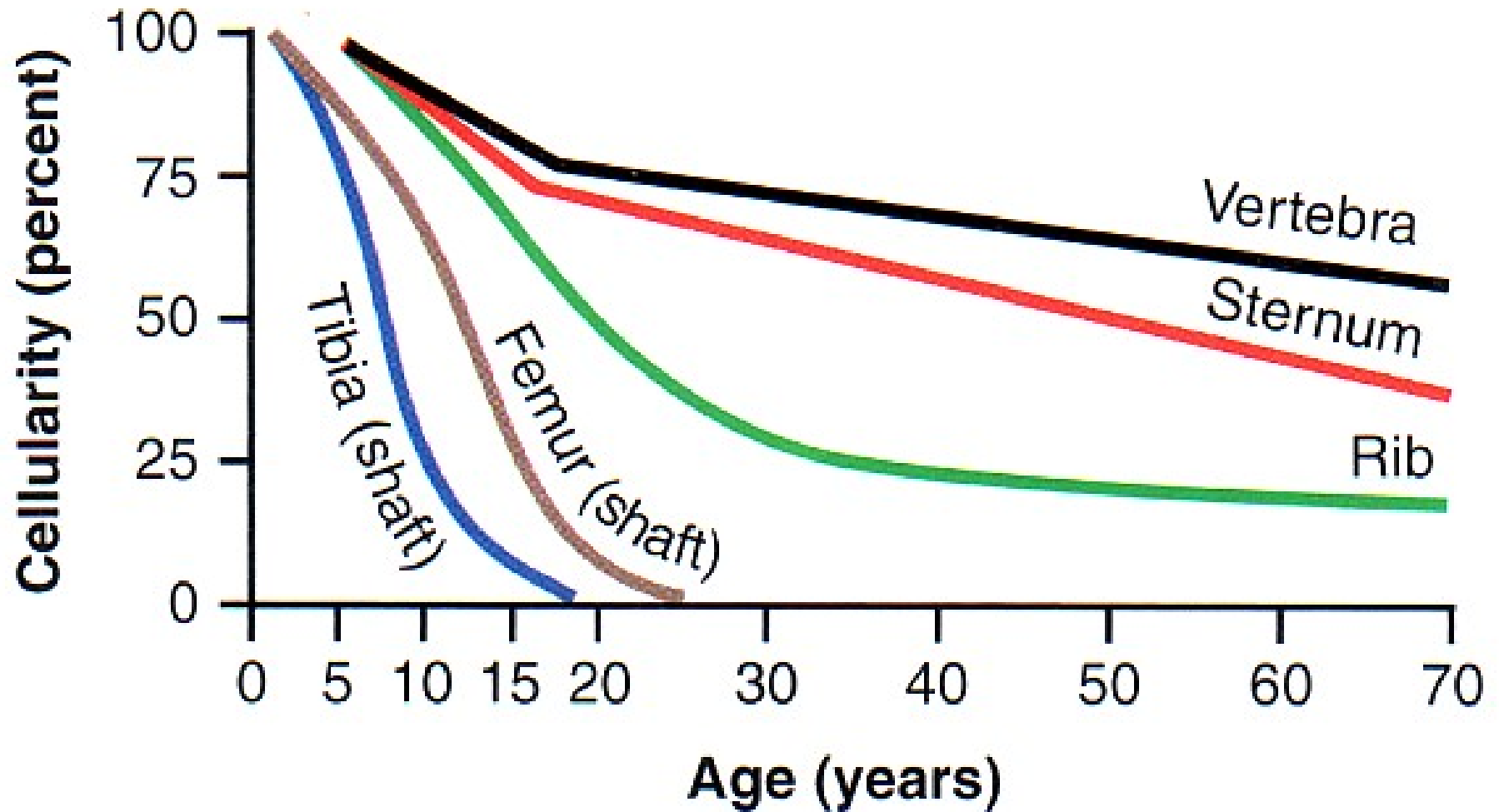




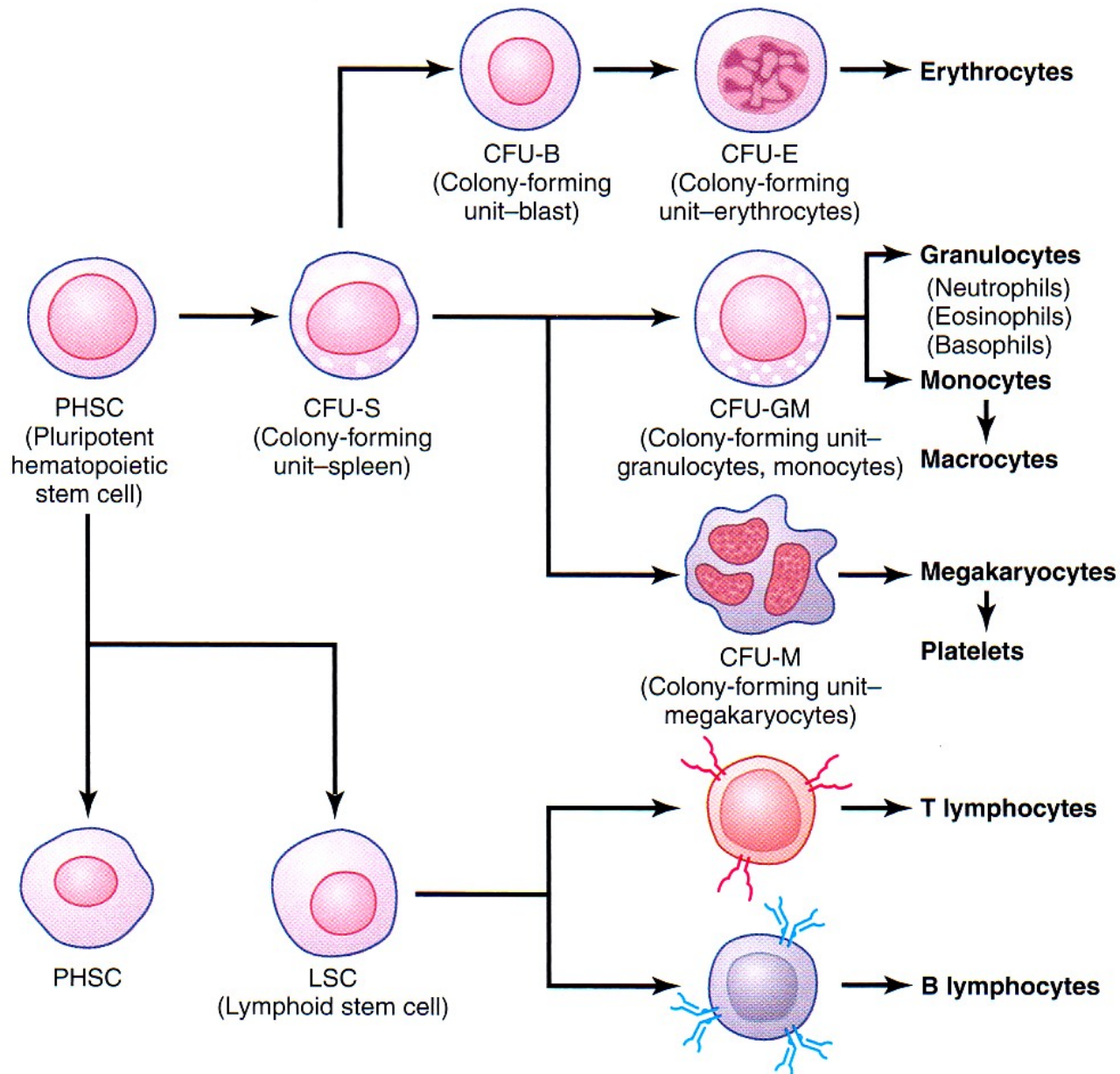


2000 x GMBH,
Nat Geog 1986
Jun p 714

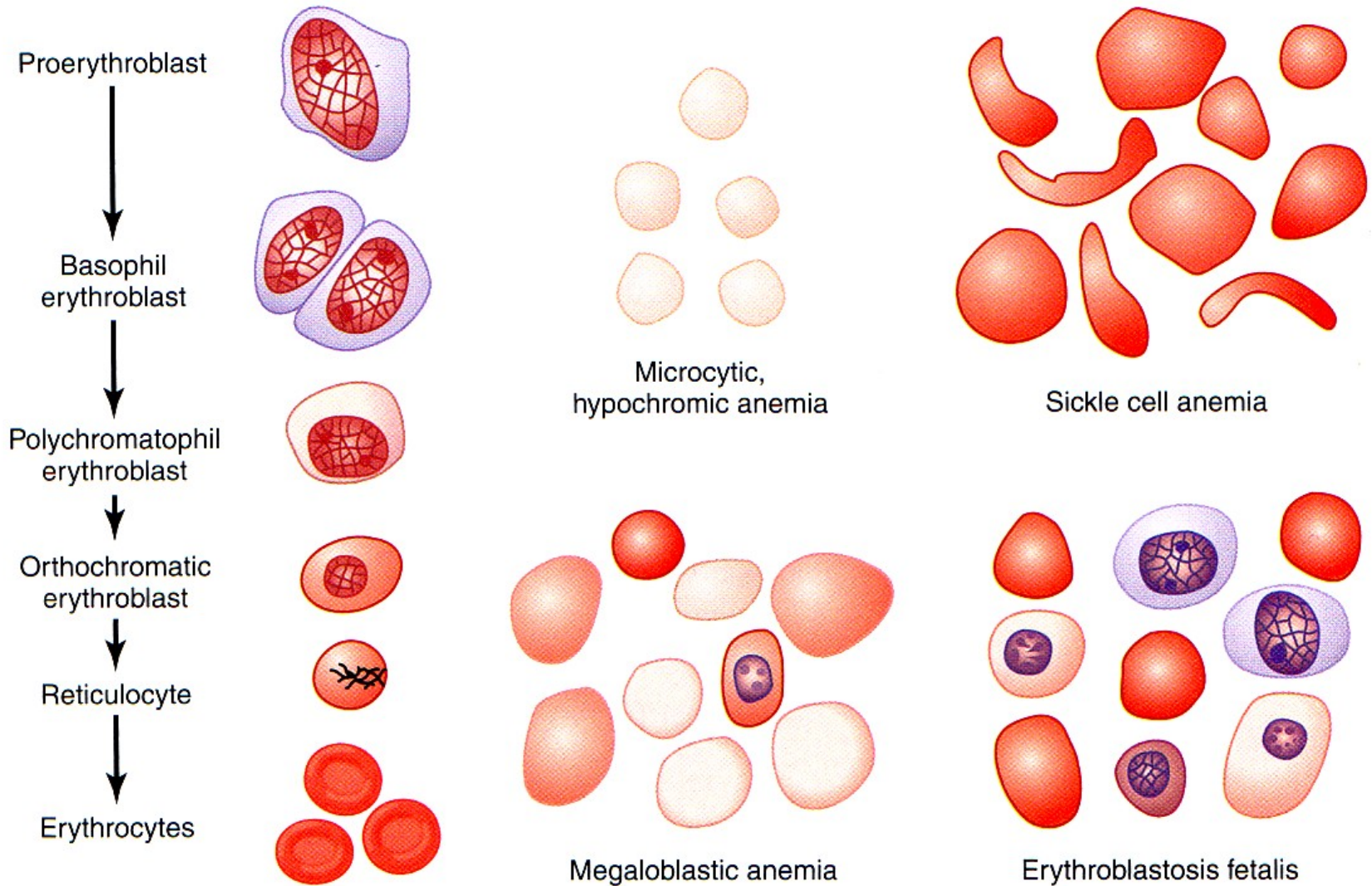
Dermal bone production of red blood cells



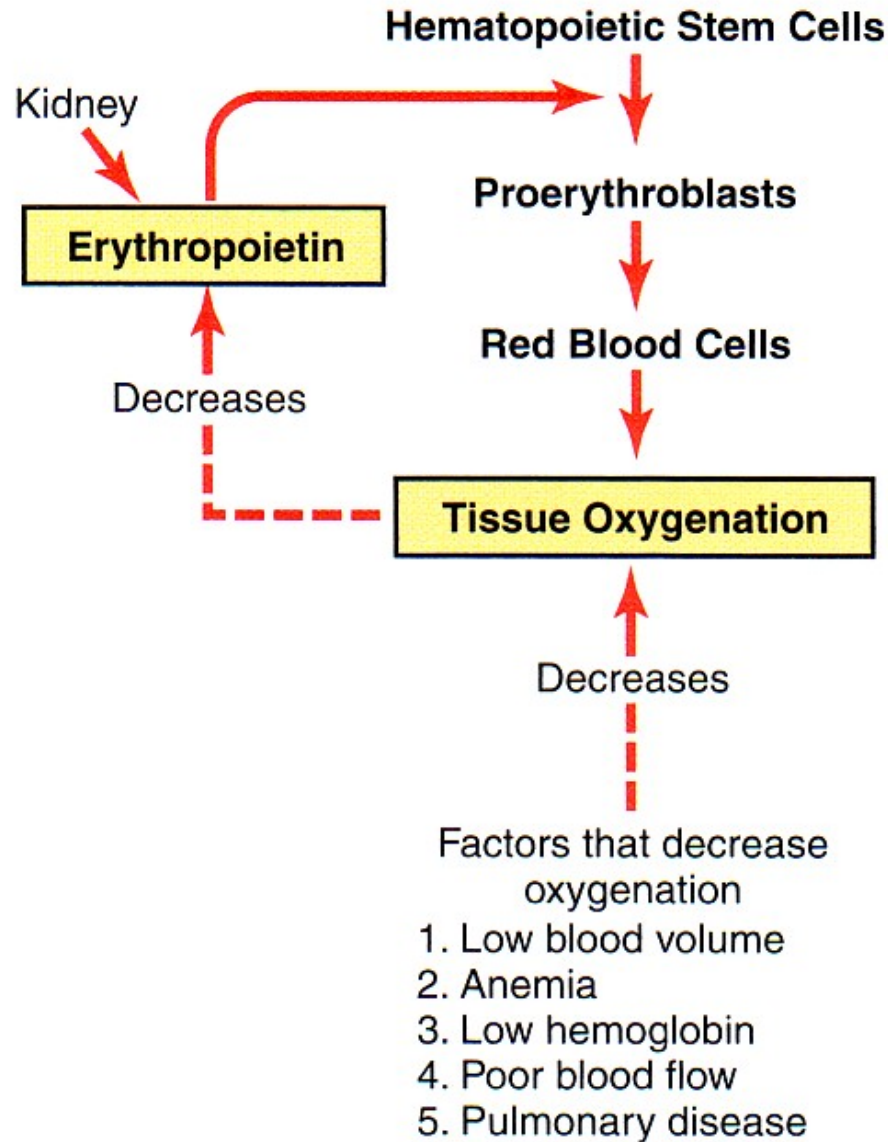
Pluripotent Hematopoietic Stem Cell Lines



Red Blood Cell Genesis

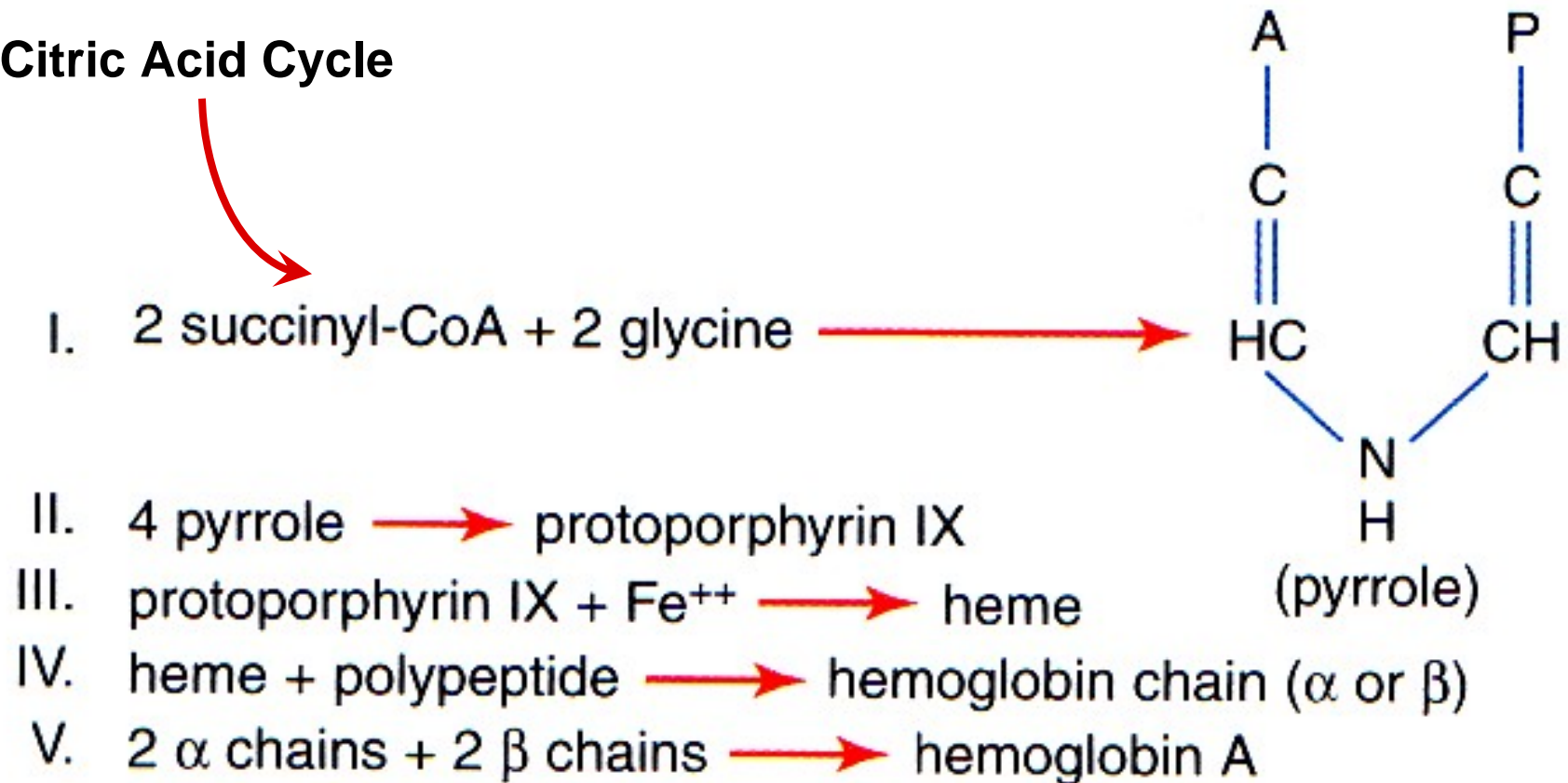


Erythropoietin Regulates RBC Production

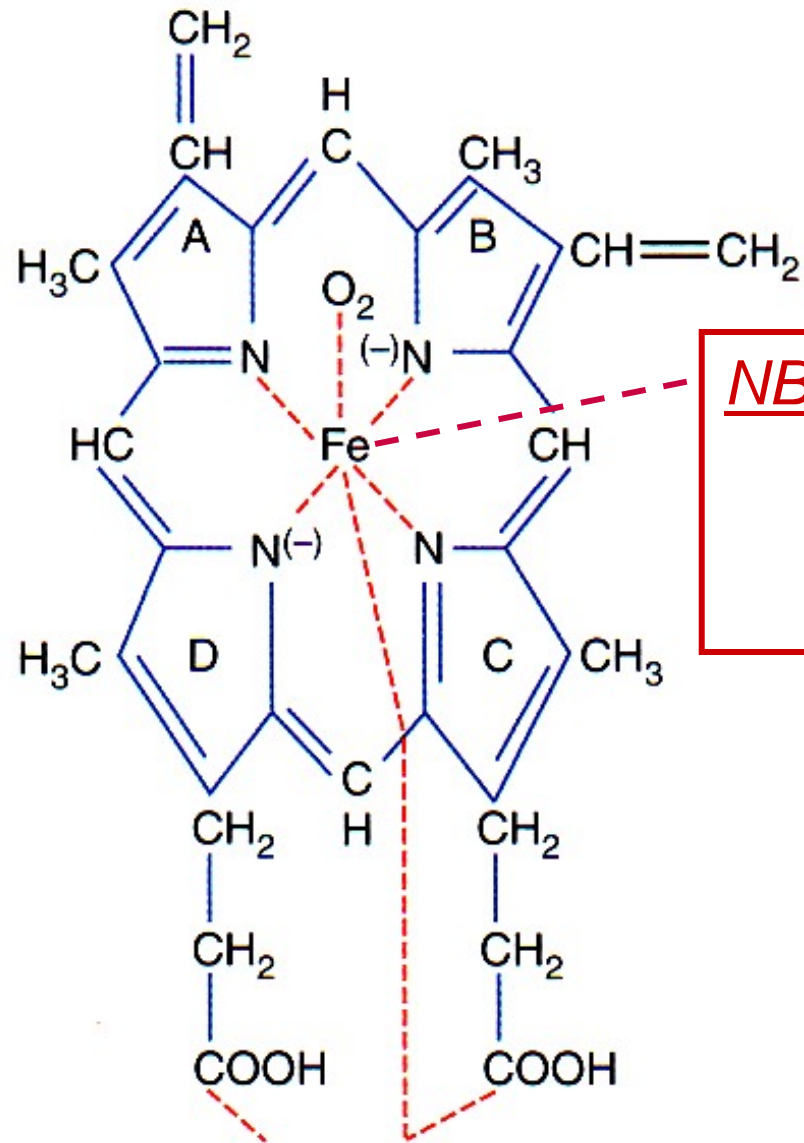


Hemoglobin Formation

Citric Acid Cycle



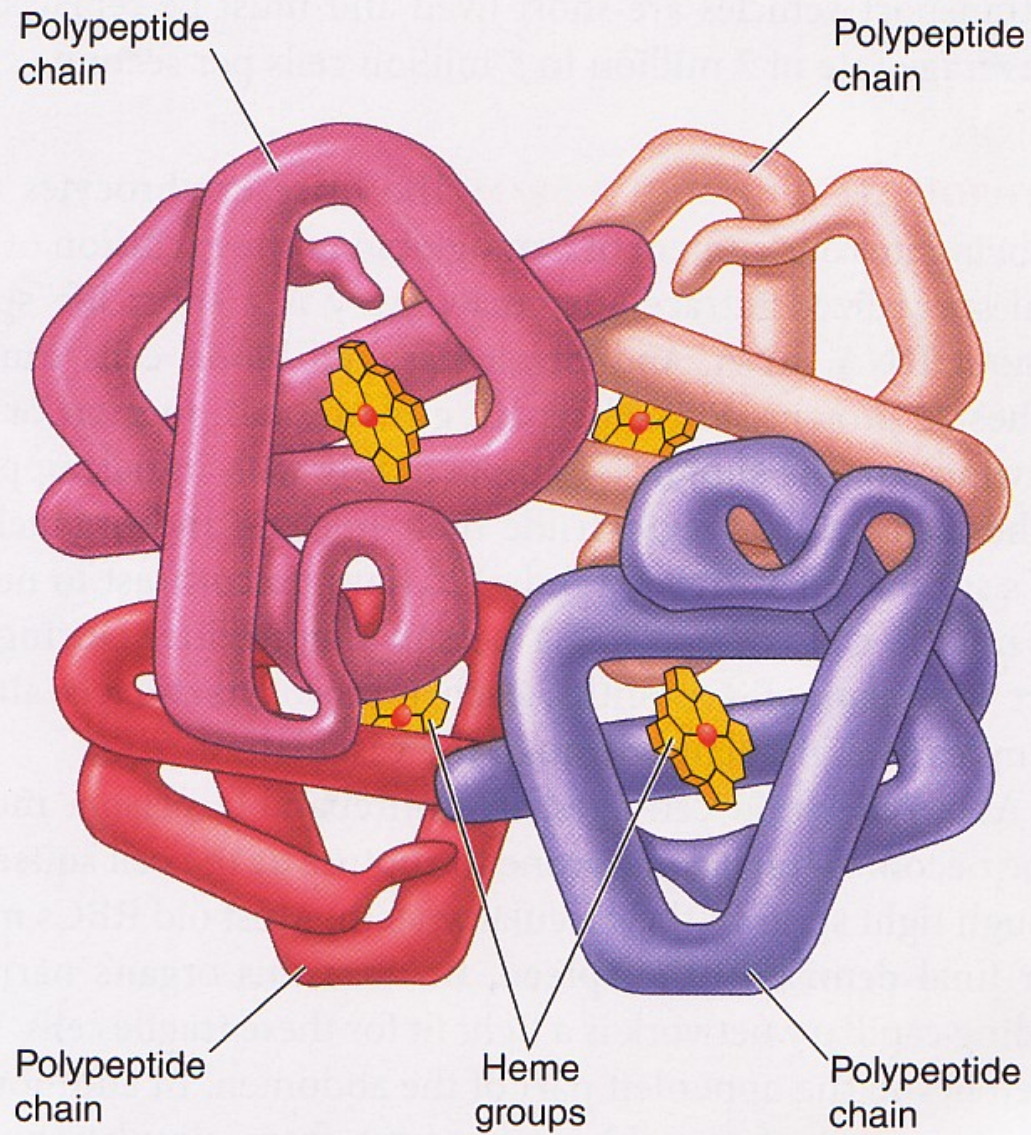
Heme Structure



NB: CO carbon monoxide binds w/~200-fold > affinity than O₂

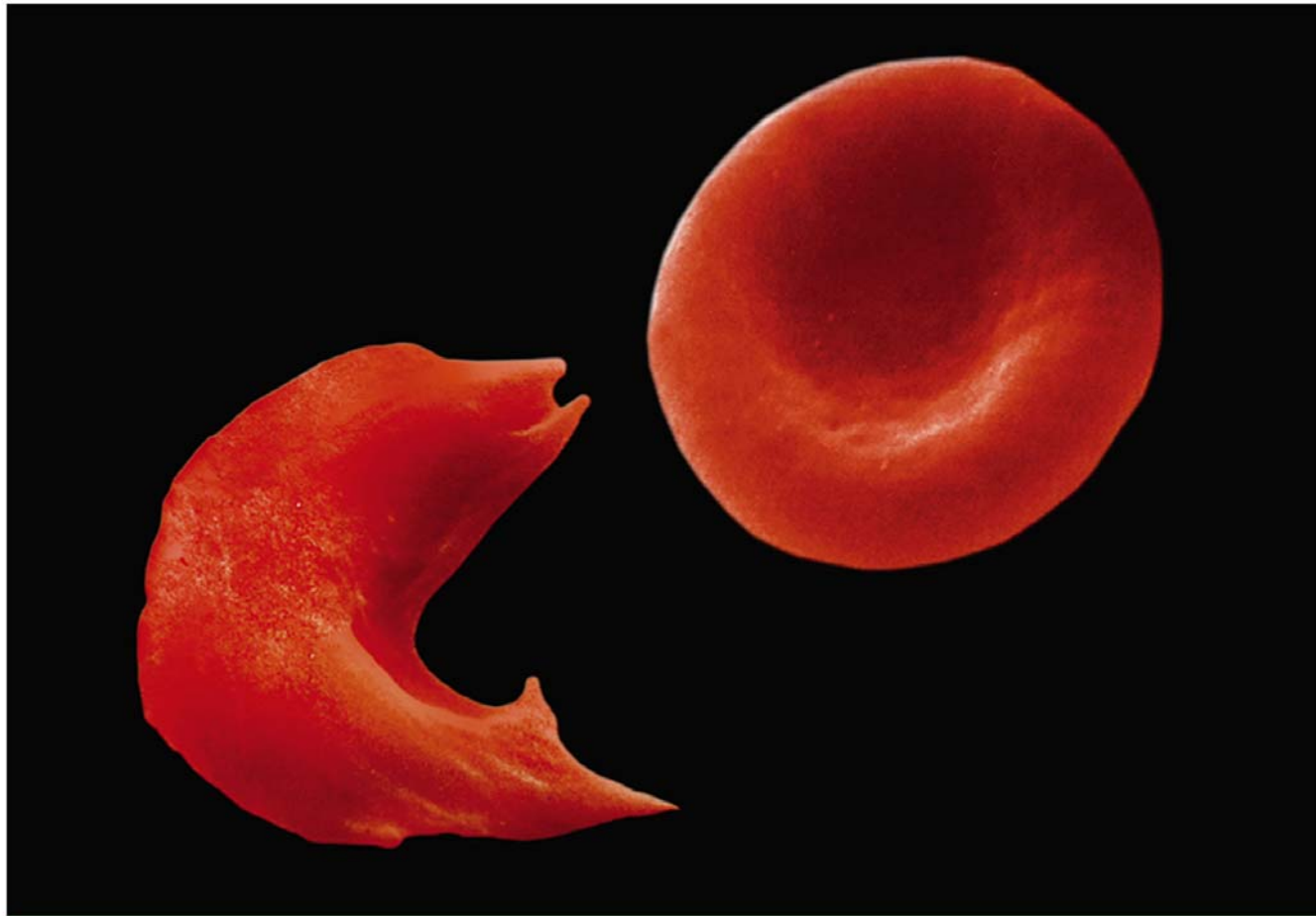
Polypeptide
(hemoglobin chain- α or β)

Hemoglobin Structure



Sickle-shaped blood cells

Normal red blood cells



© Dr. Stanley Flegler/Visuals Unlimited

What a difference one amino acid can make!

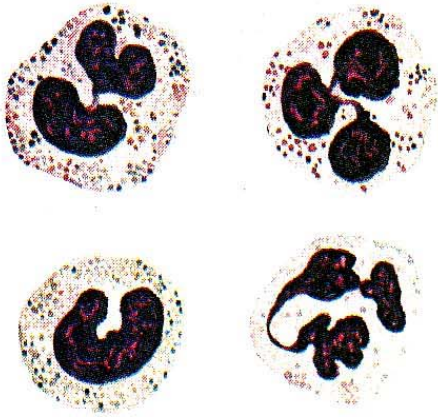
Amino acid sequence of normal hemoglobin:

Val — His — Leu — Thr — Pro — Glu — Glu

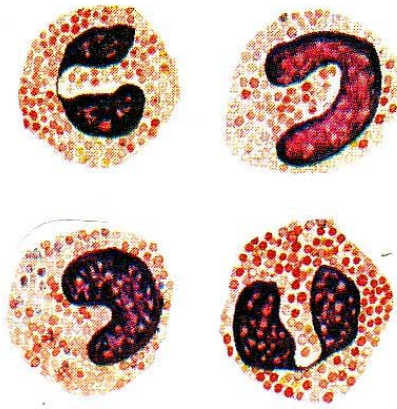
Amino acid sequence of sickle-cell hemoglobin:

Val — His — Leu — Thr — Pro — Val — Glu

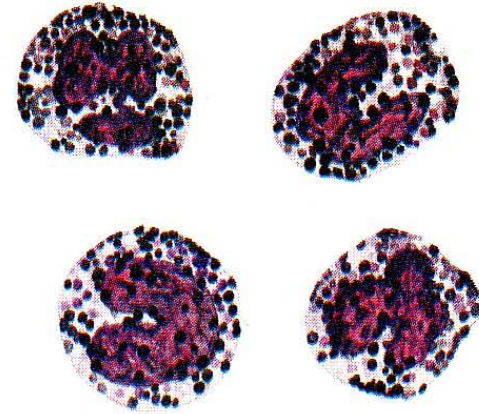
S&W 2011 fig 6-5 p 194



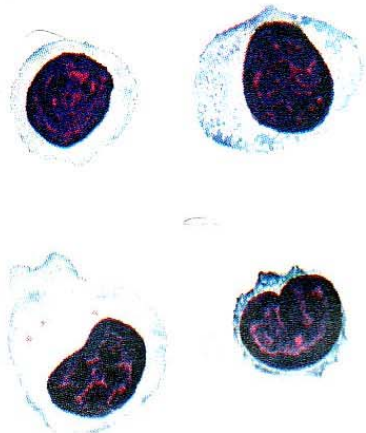
NEUTROPHILS



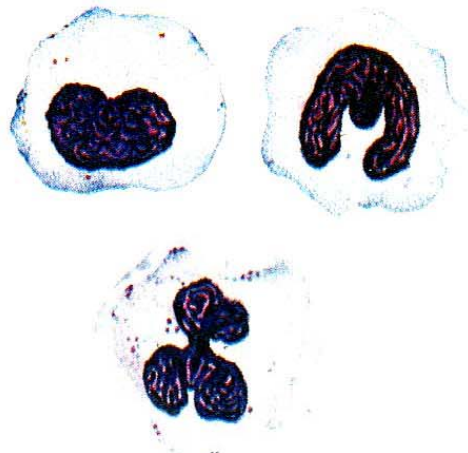
EOSINOPHILS



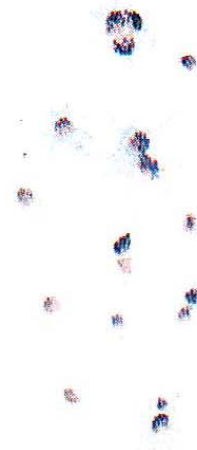
BASOPHILS



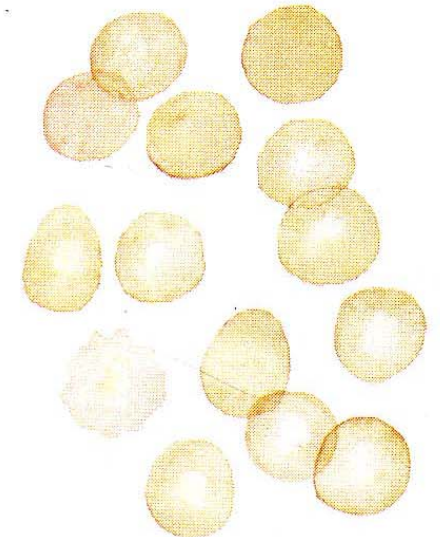
LYMPHOCYTES



MONOCYTES



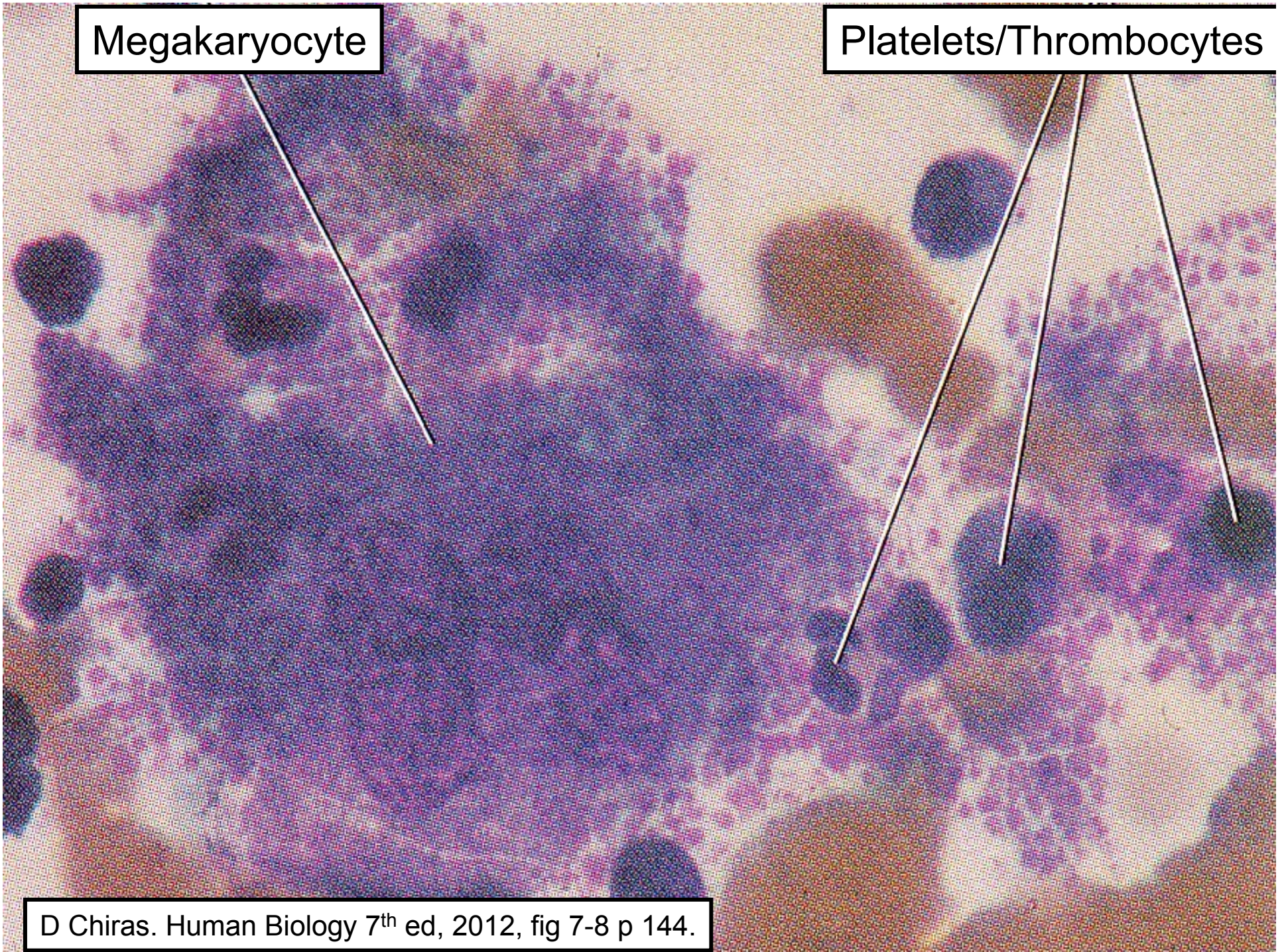
PLATELETS



ERYTHROCYTES

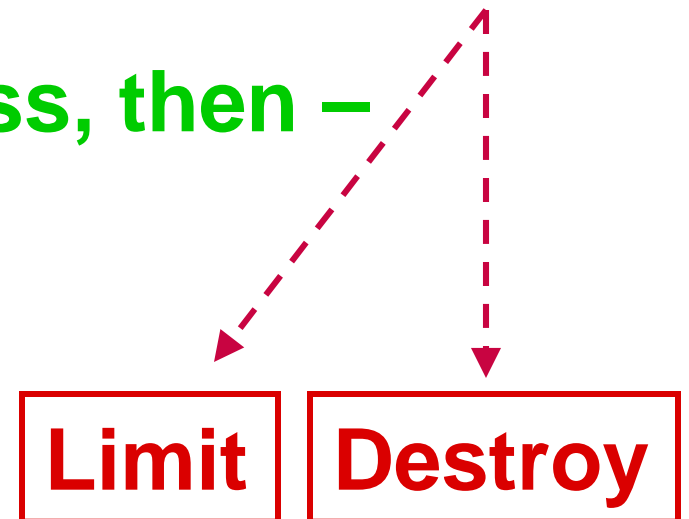
Megakaryocyte

Platelets/Thrombocytes



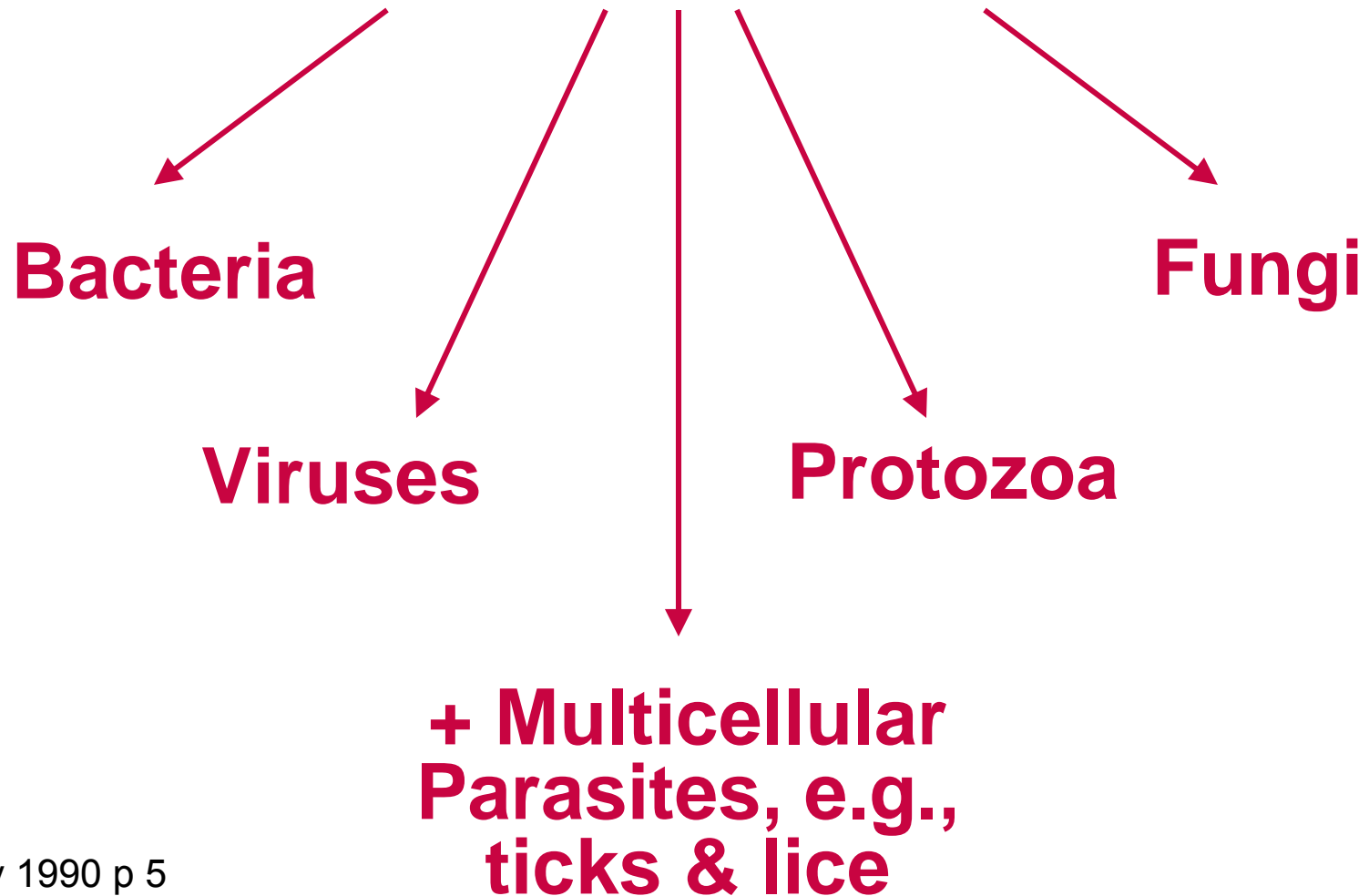
Immune Response

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!**

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!**

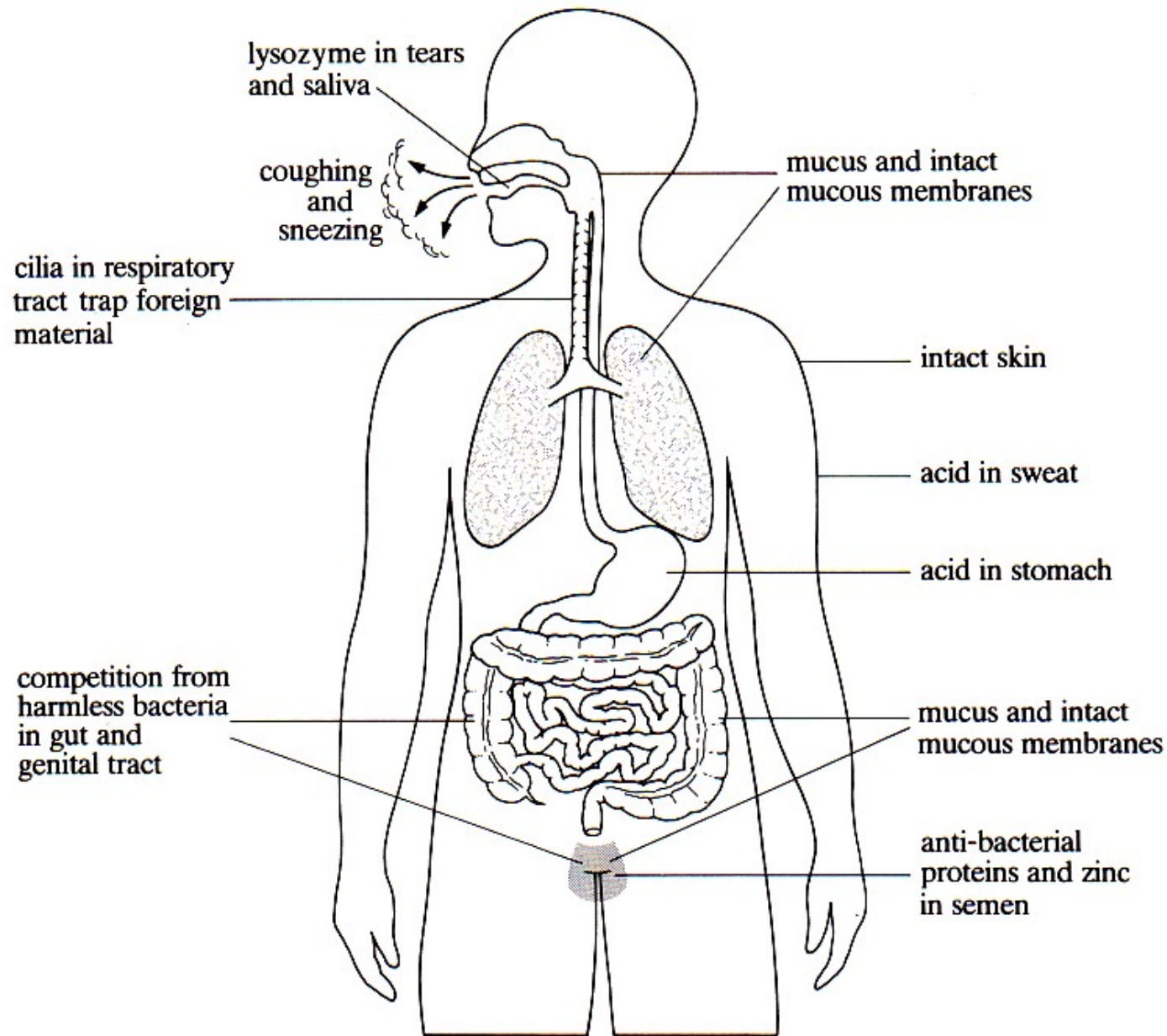
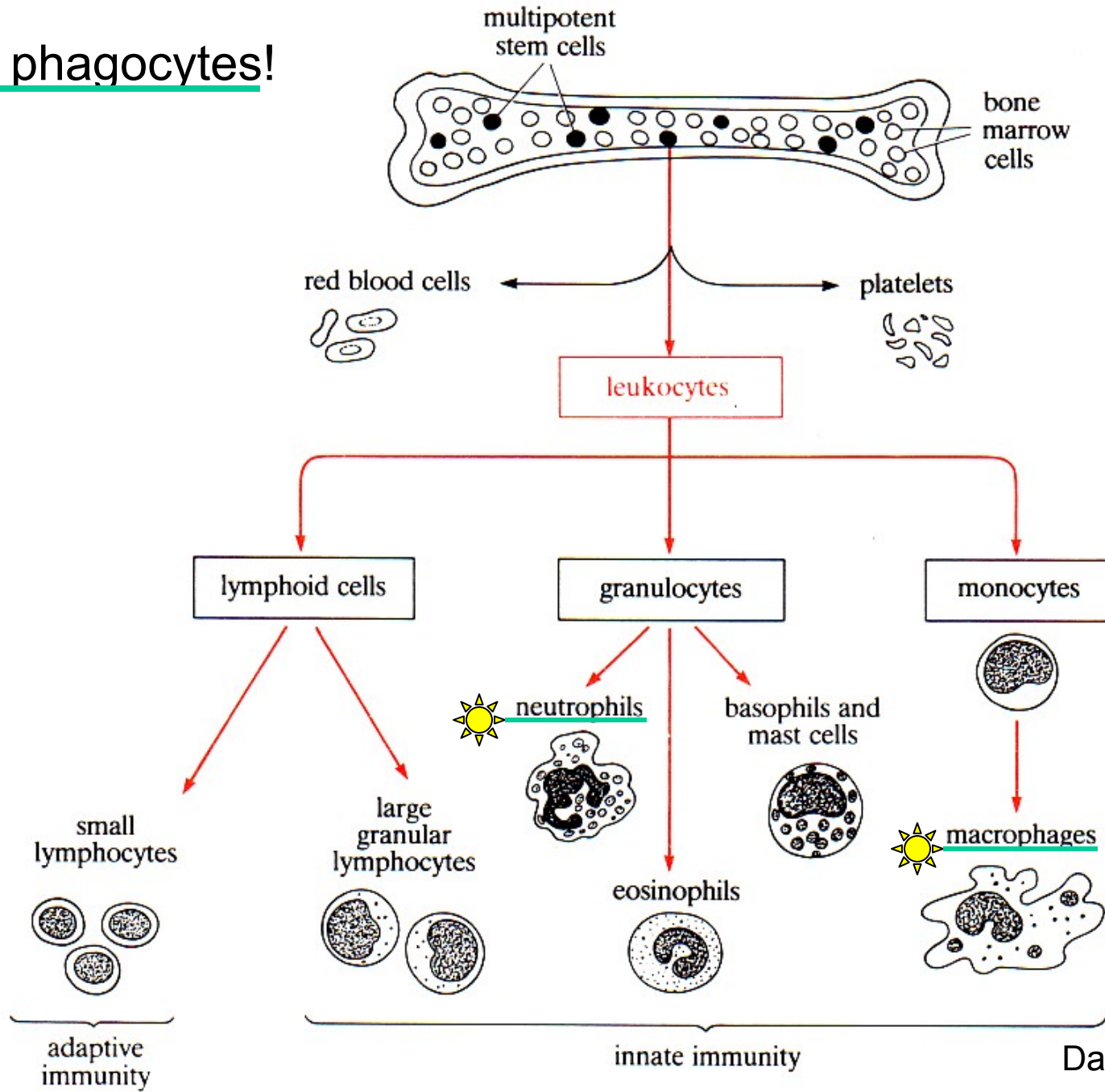


FIGURE 2.1 Summary of the main physical, chemical and mechanical barriers to infection entering the human body.

 Good phagocytes!



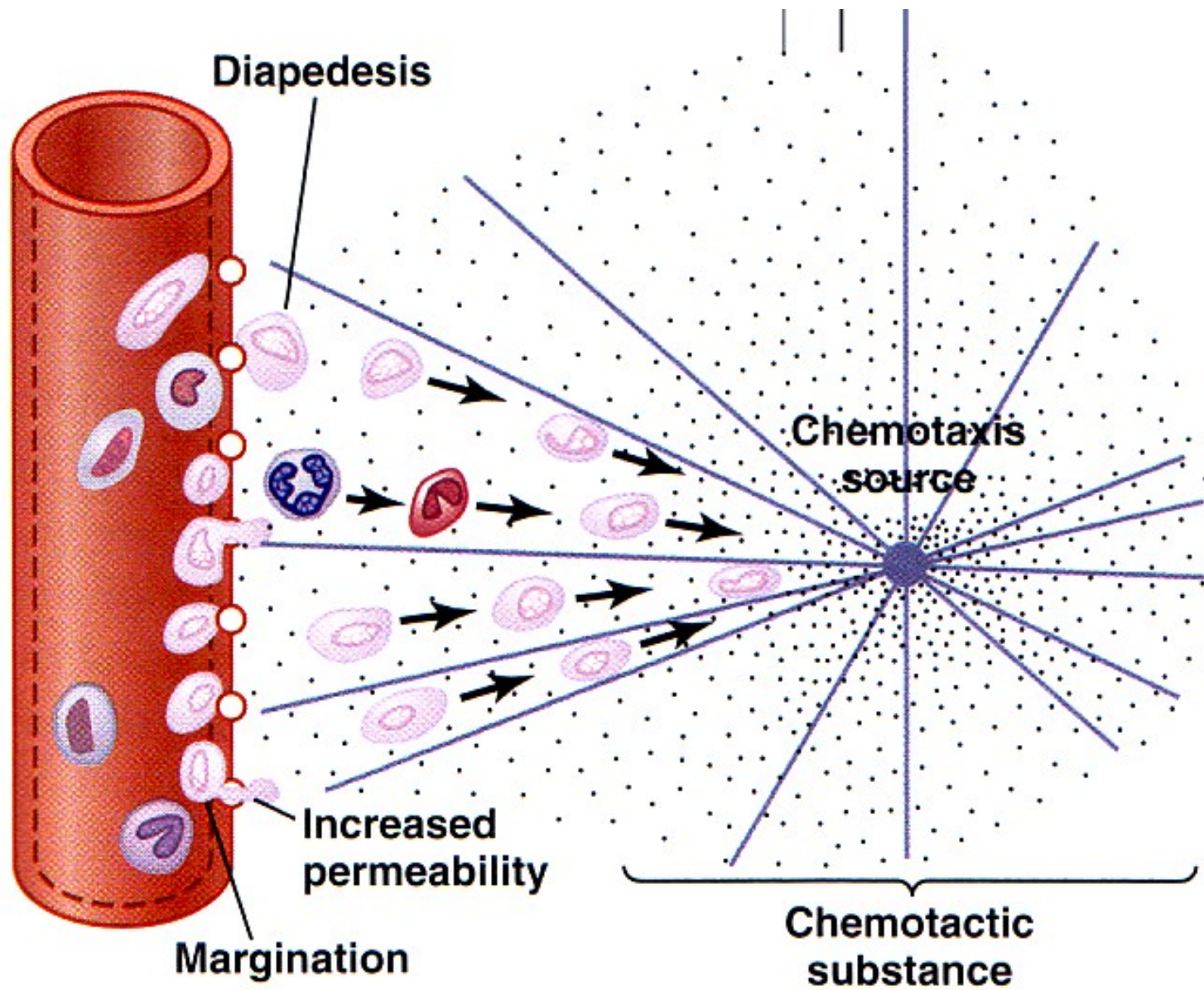
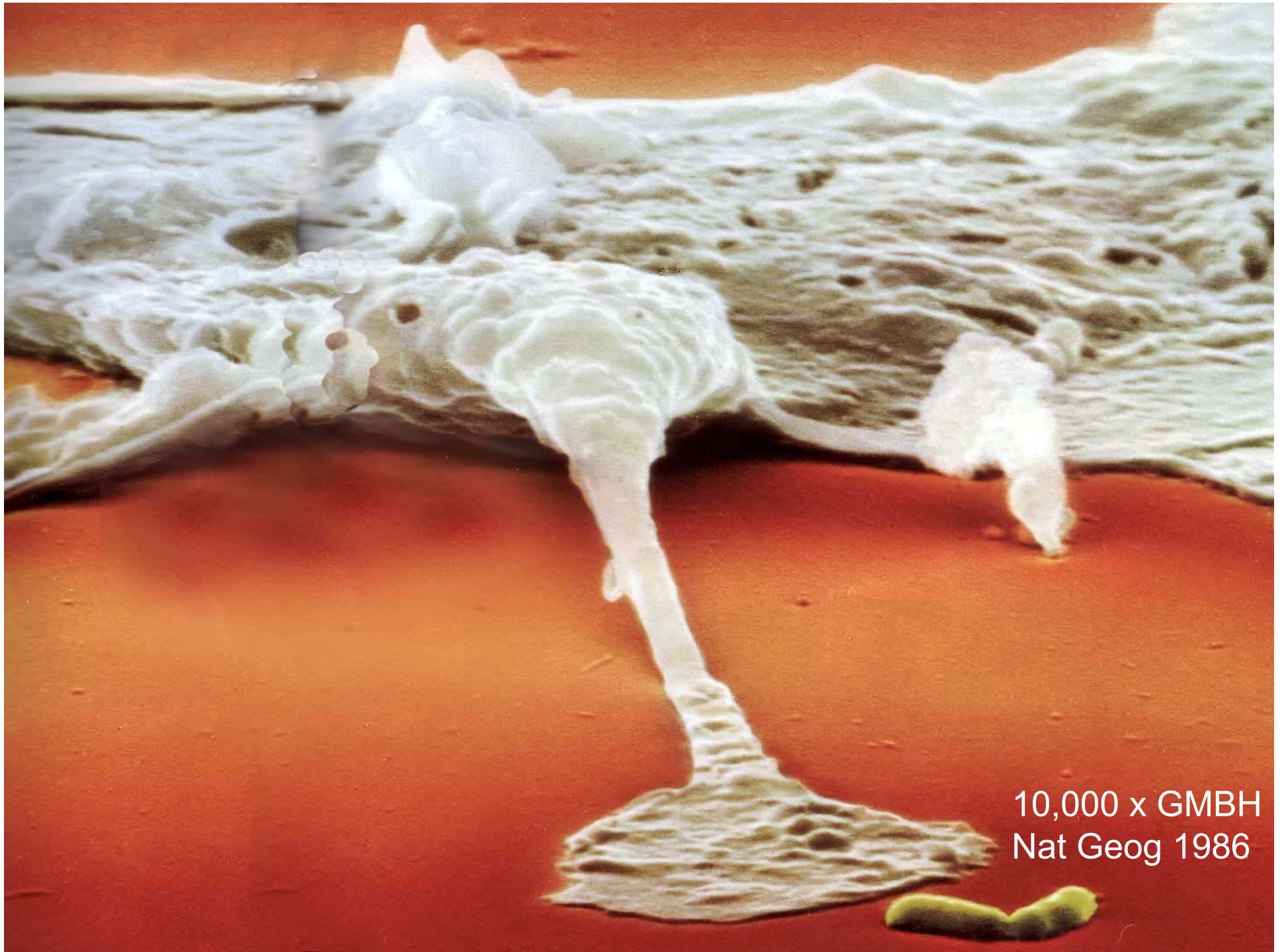
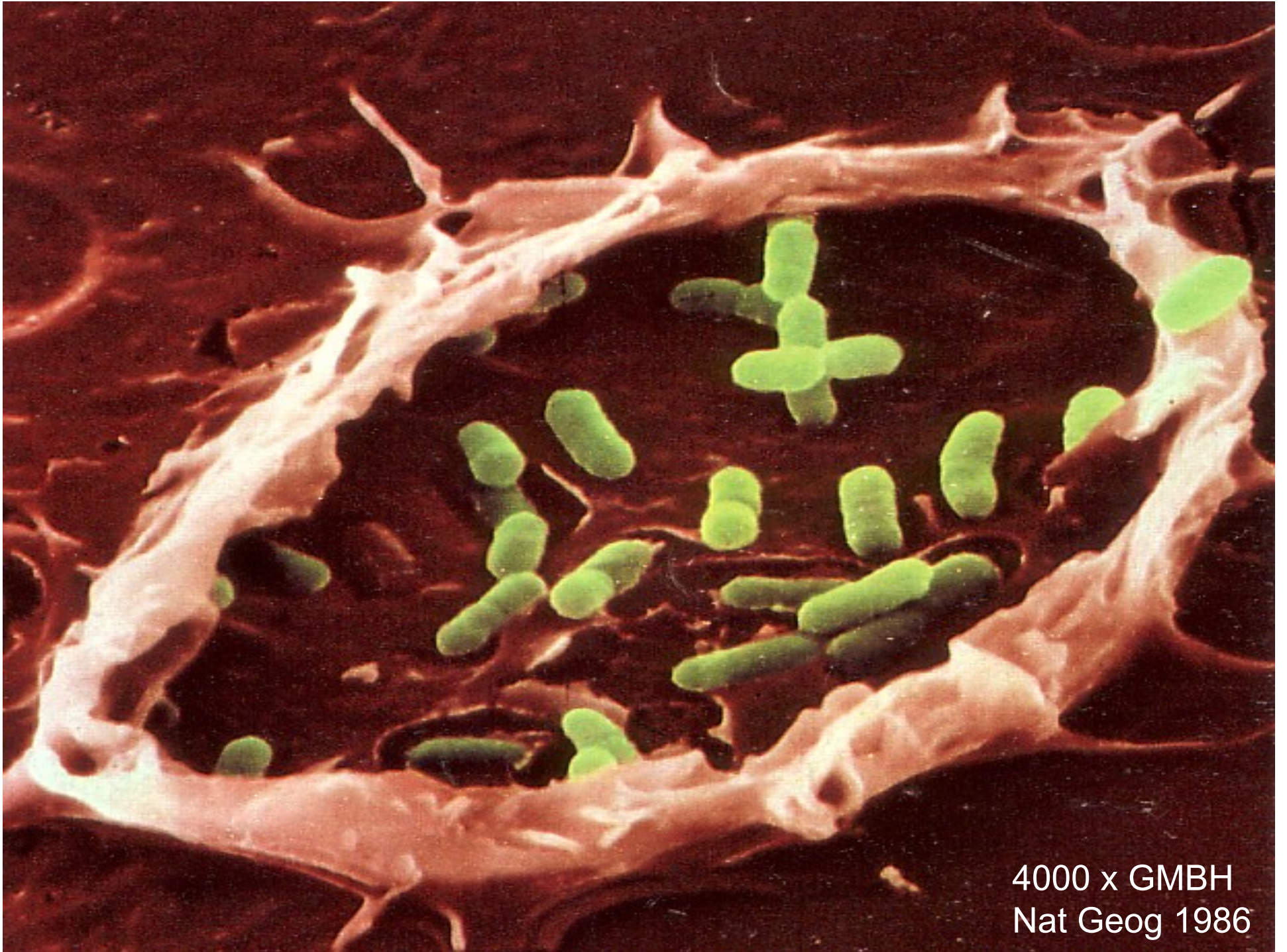


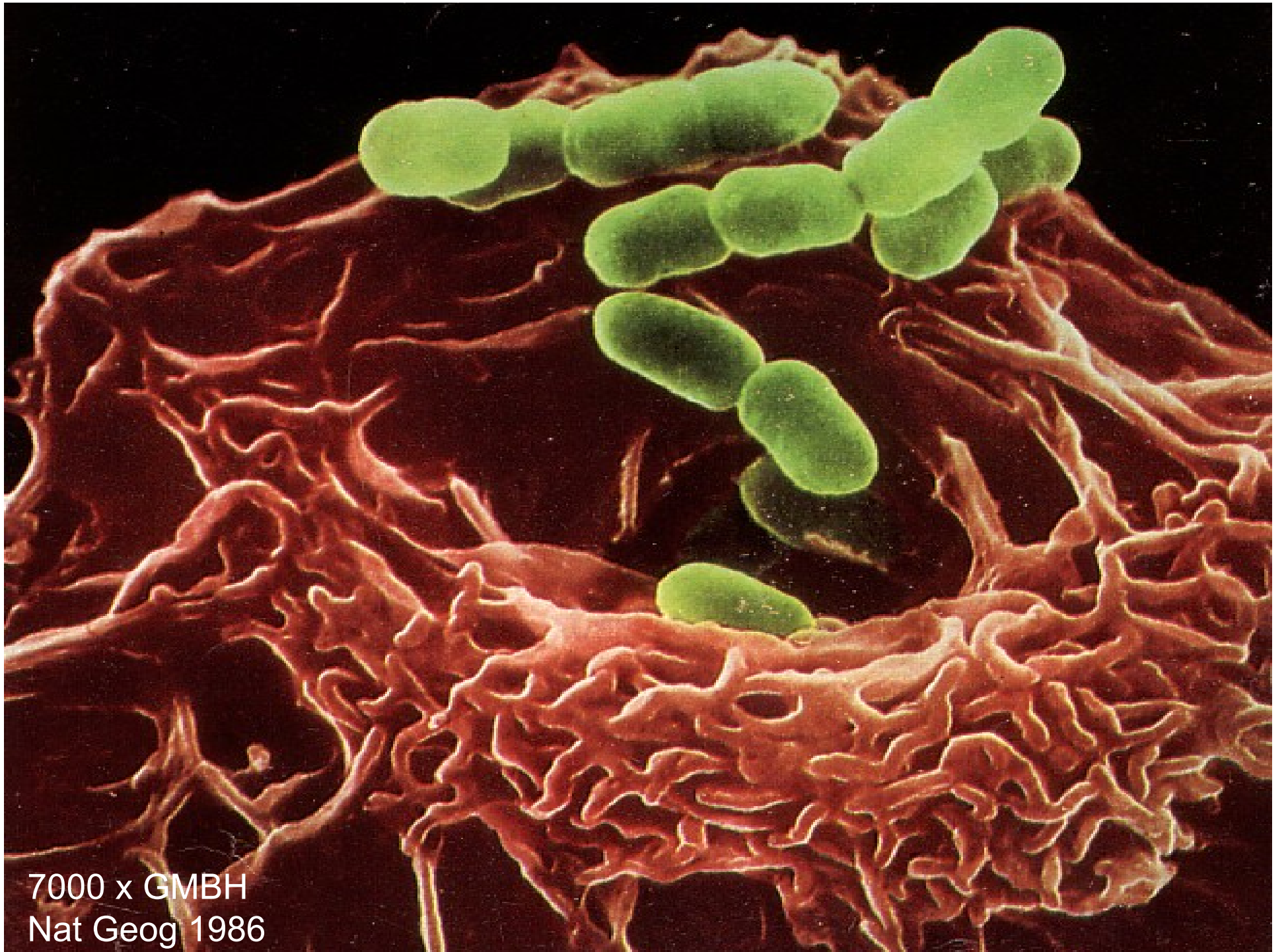
Figure 33-2 Movement of neutrophils by *diapedesis* through capillary pores and by *chemotaxis* toward an area of tissue damage. G&H 2011



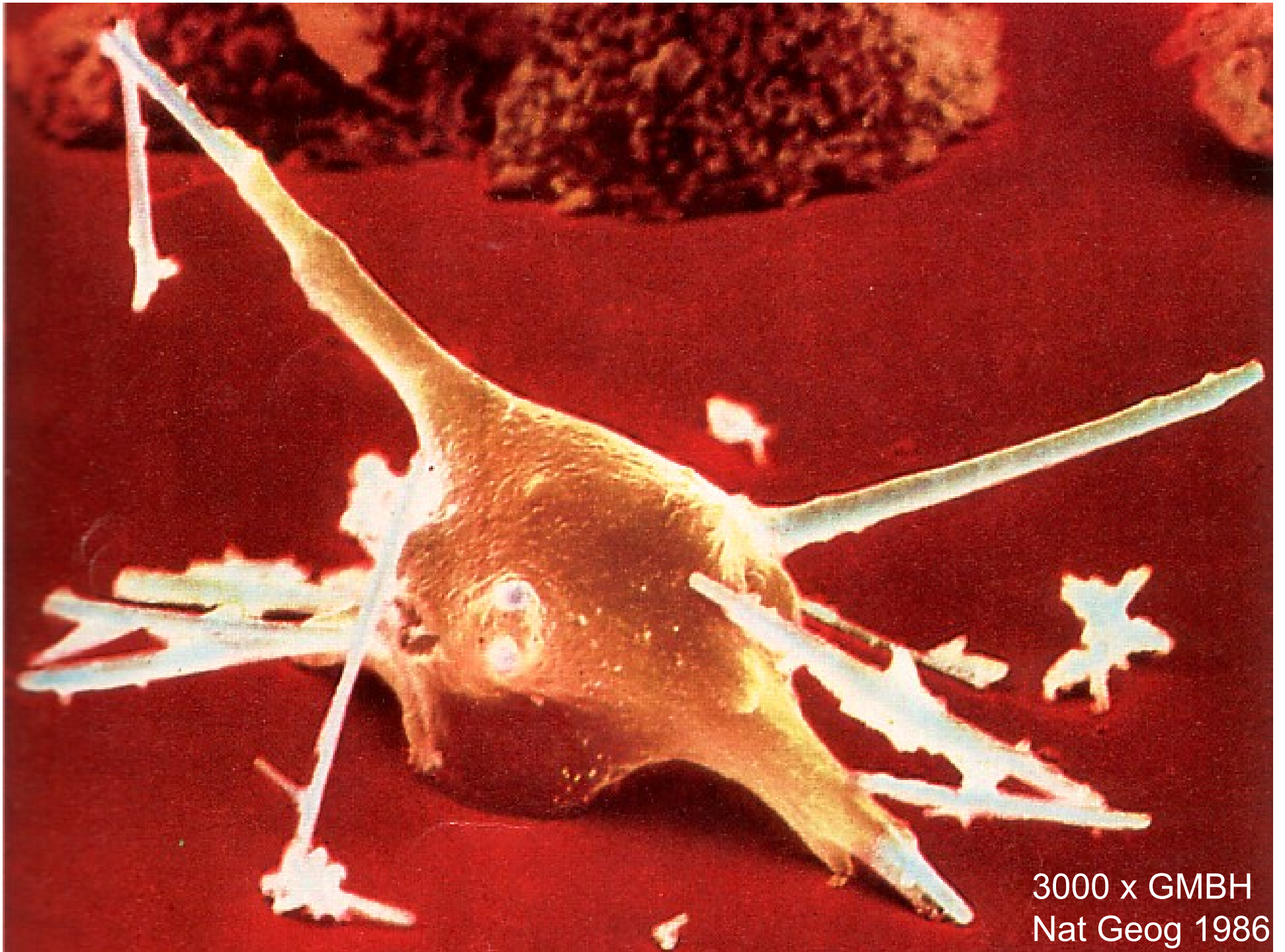
10,000 x GMBH
Nat Geog 1986



4000 x GMBH
Nat Geog 1986



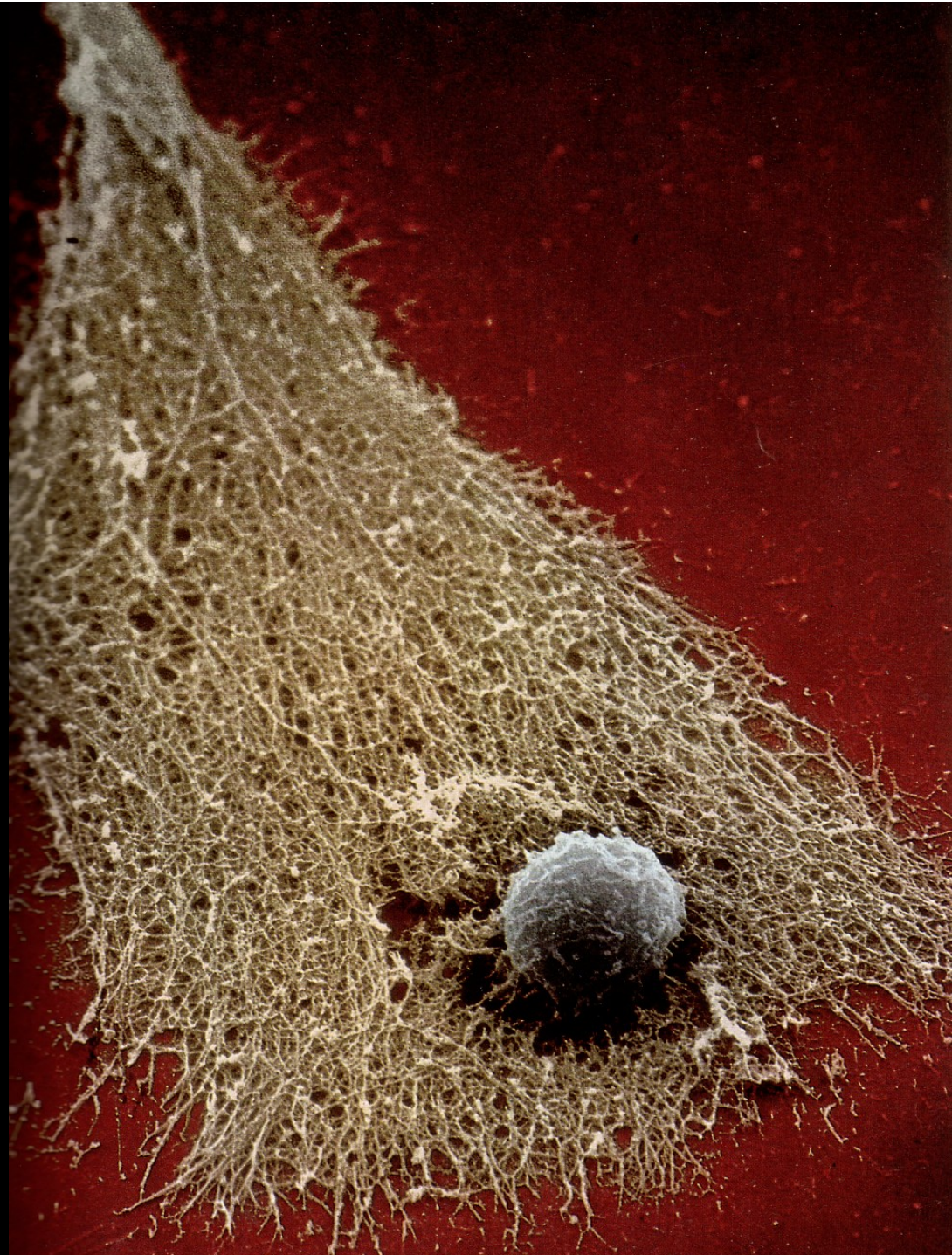
7000 x GMBH
Nat Geog 1986



3000 x GMBH
Nat Geog 1986



10,000 x GBH
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/>