…Douglas Bovee, MD, Internal & Addiction Medicine Specialist. Next Tuesday! Hooray!!

BI 358 Lecture 1- Happy New Year 2017!

I. *Introductions/Announcements* Staff: Stacy, Conor & Pat
Discussions today 10am,12n, 2 pm 112 HUE, registration Q?

II. *Outline Handout* Office hr, text (G&H), discussion/lecture notebook (DLN), optional text, attendance & participation, feedback, quizzes, presentation & paper, expectations, Q?

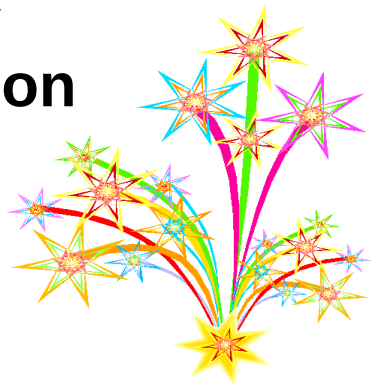
III. *Discussion Preview* Cigarettes & addiction, e-cigarettes?

IV. *Dr. Eugene Evonuk, Dr. Arthur Guyton & Dr. John Hall*

V. *Introduction to Human & Medical Physiology*
Anatomy *vs.* Physiology, Structure *vs.* Function

VI. *Body Levels of Organization* LS

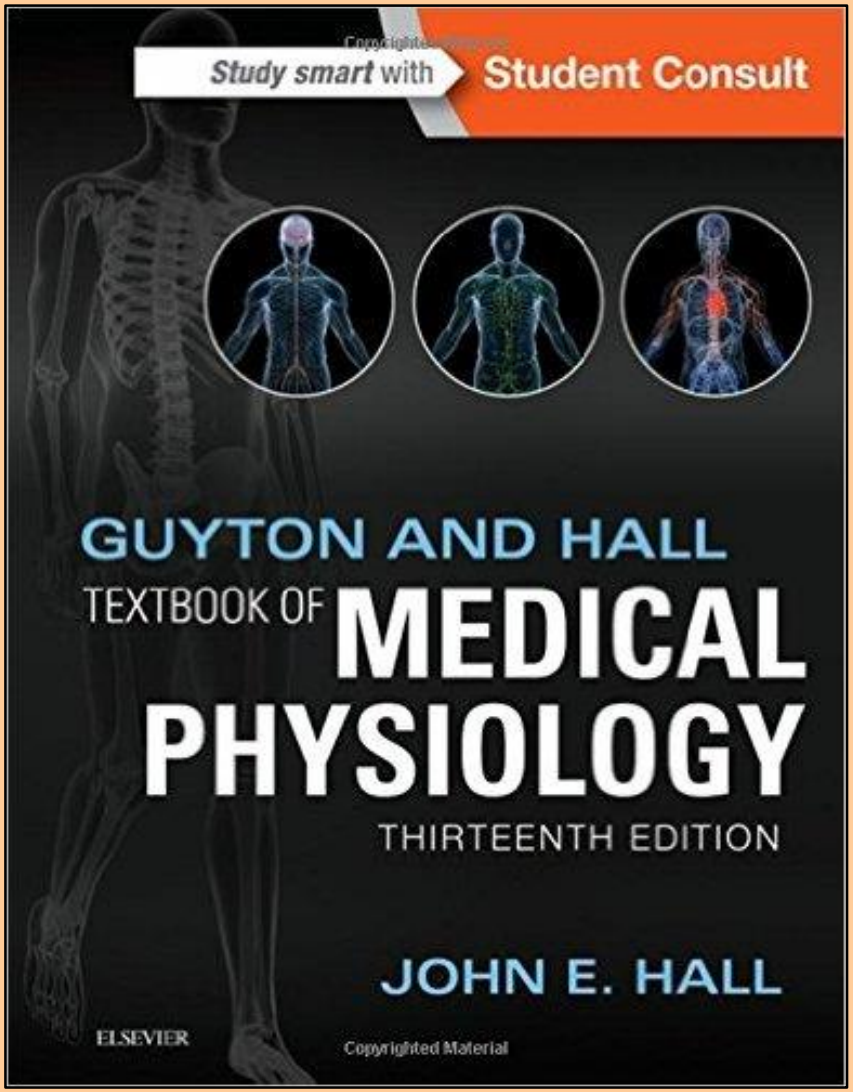
VII. *Homeostasis + 4 Key Q?* G&H + DLN



A. Brief History G&H p 3
B. What? → Maintenance of ECF, p 4
C. Where? → ECF = Plasma + interstitium pp 4-5, fig 1-2 p 4
D. Why? → Required for cell survival LS + G&H p 8, 9
E. ECF Balances + *e.g.*? H_2O, T°C Dr. Evonuk DLN p A-1, A-2
F. How? → Simplified homeostatic model (Norris & Evonuk)
- feedback *e.g.* pp 6-8, + feedback G&H fig 1-3, p 8

BI 358 Required Texts

http://uoduckstore.com/



Biology 358:

Investigations in Medical Physiology

Discussion-Lecture Notebook (DLN)

Eugene, OR 97403

Winter 2017

G&H **DLN**

New $120.00 Used $90.00 Rental $75.00…Notebook $ 25.60

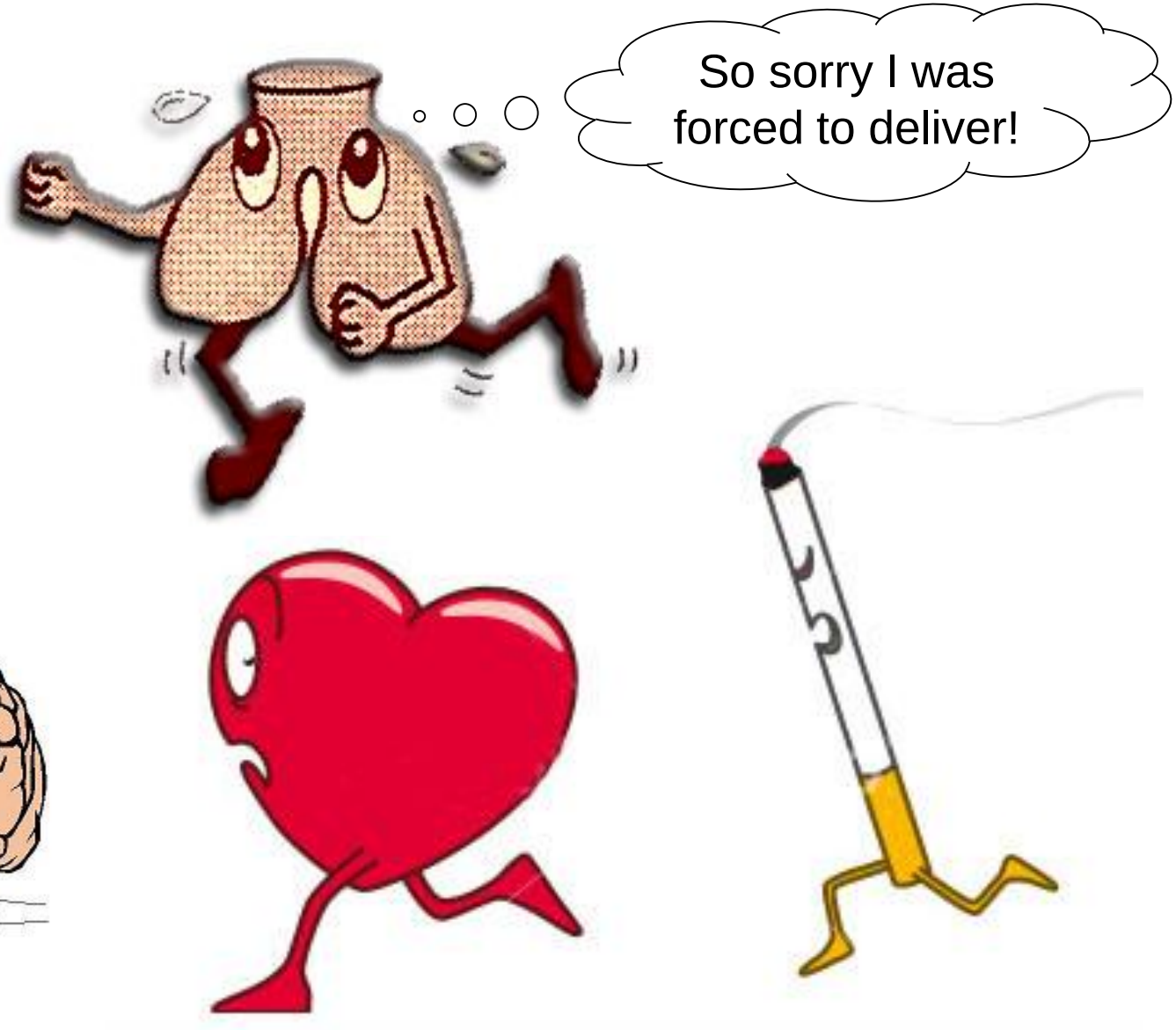
☞☺...I ♡ U of O!

Students who succeed are usually those who:

(1) **Attend** class regularly
(2) **Ask** questions
(3) **Come** to office hours & problem-solving sessions
(4) **Study** outside class both alone & in study groups
(5) **Seek** to understand methods & overarching principles/concepts rather than specific answers
(6) **Teach** or tutor others &
(7) **Discuss** concepts informally with fellow students.

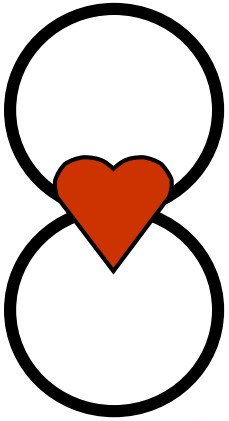
Science Teaching Reconsidered, National Academy Press, 1997.

Not only the Lungs, Heart & Brain, but 100s of Other Tissues & Organs are Adversely Affected!

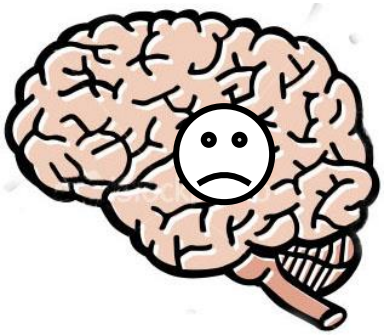


Cigarettes ≡ Patient-Assisted Drug-Delivery System
Inhaling Bypasses the Systemic Circulation
& Is Powerfully Reinforcing!

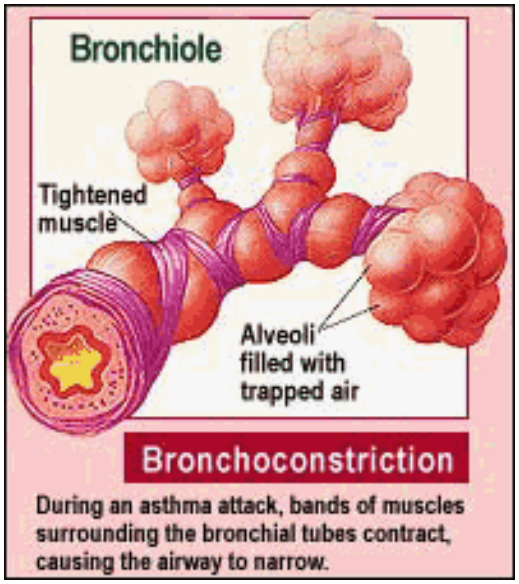
Pulmonary



Systemic



SMOKING ≡ ASTHMA?



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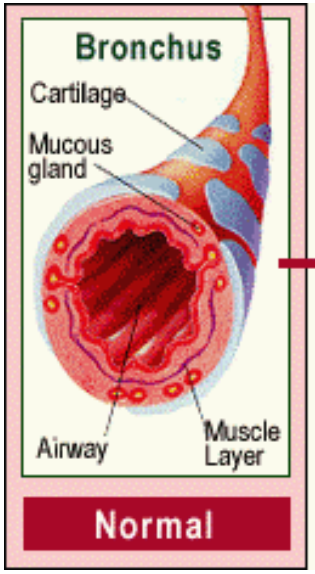

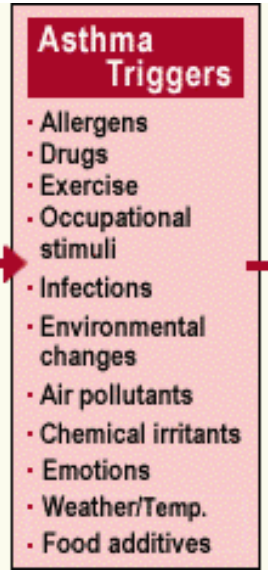

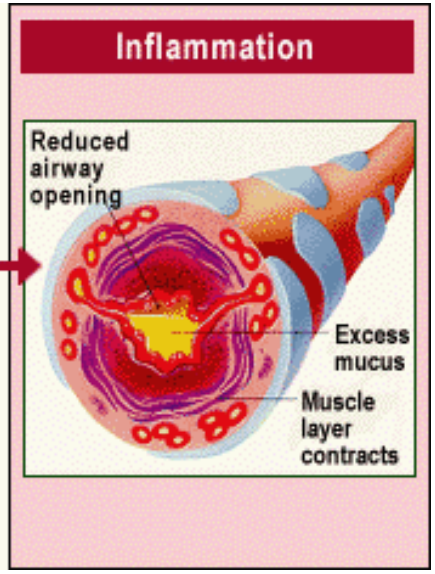

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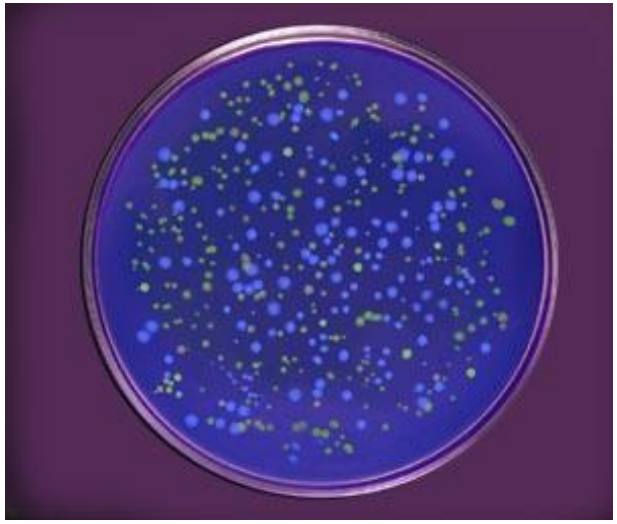
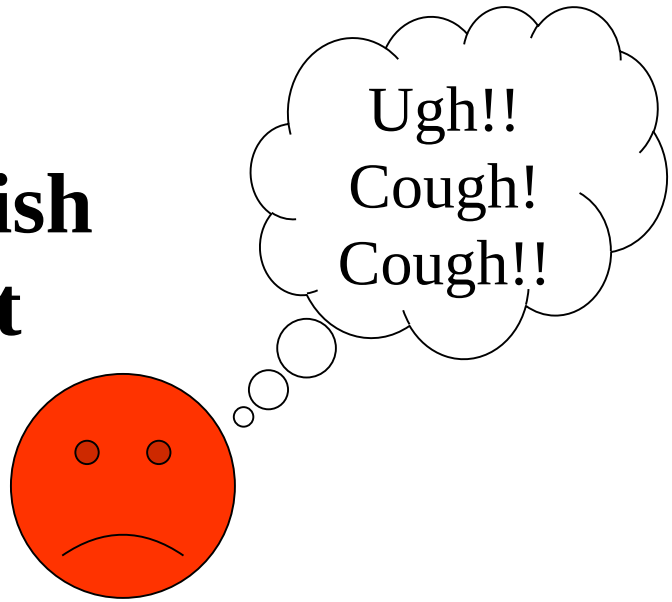


Petri-dish Effect



Tracing the Route of Cigarette Smoke
Puff to Brain Time 5 to 8 seconds!!

Mouth

↓

Pharynx

↓

Larynx

↓

Trachea

↓

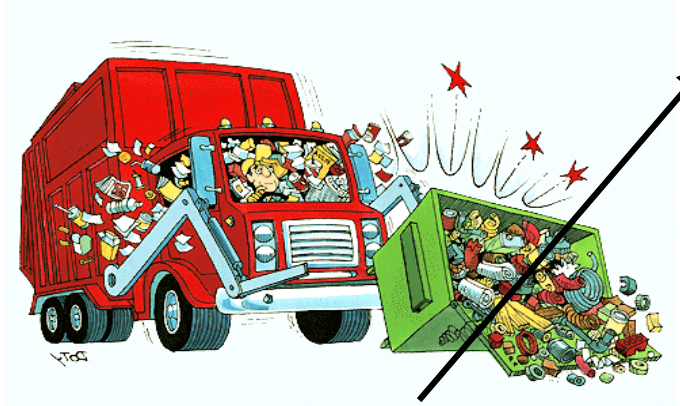
Bronchi

↓

Bronchioles

↓

Alveoli



Blood

Pulmonary Veins

↓

Left Atrium

↓

Left Ventricle

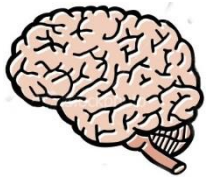
↓

Aorta

↓

Heart

Brain



Systemic Circulation

Respiratory Membrane

Cigarette + Smoke: > 7000 Chemicals; ~600 Tobacco Company Additives Atherogenic, Carcinogenic (C), Tumor Initiating, Tumor Promoting (TP), Toxic (T), Cornucoppia of Unknowns, Synergistic, Reactive...?

4-aminobiphenyl	C	140 ng per cigarette...
benz(a)anthracene	C	40-200 ng
benzene	C	400 µg
benz(o)pyrene	C	40-70 ng
carbon monoxide	T	26.8-61 mg
formaldehyde	C	1500 µg
hydrazine	C	90 ng
hydrogen cyanide	T	14-110 µg
2-napthylamine	C	70 ng
nitrogen oxides	T	500-2000 µg
N-nitrosodimethylamine	C	200-1040 ng
N-nitrosodiethanolamine	C	43 ng
N-nitrospyrrolide	C	30-390 ng
phenol	TP	70-250 µg
polonium 210	C	0.5-1.6 pCi
quinoline	C	15-20 µg
O-toluidine	C	3 µg

***SOURCES*: *US Surgeon General's Office*, *American Cancer Society*, *American Heart Association*.**

horic Acid, Pimenta Leaf Oil, Pine Needle Oil, Pine Oil, Scotch, Pineappl
ntrate, alpha-Pinene, beta-Pinene, D-Piperitone, Piperonal, Pipsissewa L
Potassium Sorbate, 1-Proline, Propenylguaethol, Propionic Acid, Propyl
Hydroxybenzoate, Propylene Glycol, 3-Propylidenephthalide, Prune Juice
ne, Pyroligneous Acid And Extract, Pyrrole, Pyruvic Acid, Raisin Juice Co
nol, Rose Absol Oil, Rum, Rum Ether, Rye Extract,
age Oleoresin, alwood Oil, Yellow, Sclareolide, Ska
, Snakeroot Oil, ium Benzoate, Sodium Bicarbonate
nate, Sodium C e, Sodium Hydroxide,Solanone, Spe
t, Gum and Oil, Sucrose Octaacetate, Sugar Alcohols, Sugars, Tagetes
ic Acid, Tea Leaf and Absolute, alpha-Terpineol, Terpinolene, Terpinyl Ac
8-Tetrahydroquinoxaline, 1,5,5,9-Tetramethyl-13-Oxatricyclo(8.3.0.0(4,9))
5, and 3,4,5,6-Tetramethylethyl-Cyclohexanone, 2,3,5,6-Tetramethylpyraz
chloride, Thiazole, 1-Threonine, Thyme Oil, White and Red, Thymol, Toba
pherols (mixed), Tolu Balsam Gum and Extract, Tolualdehydes, para-Tol

Absorbs H_2O
Preserves tobacco
Antifreeze & de-icing
Polyester compounds
Artifical smoke in
Theater & e-cigarettes

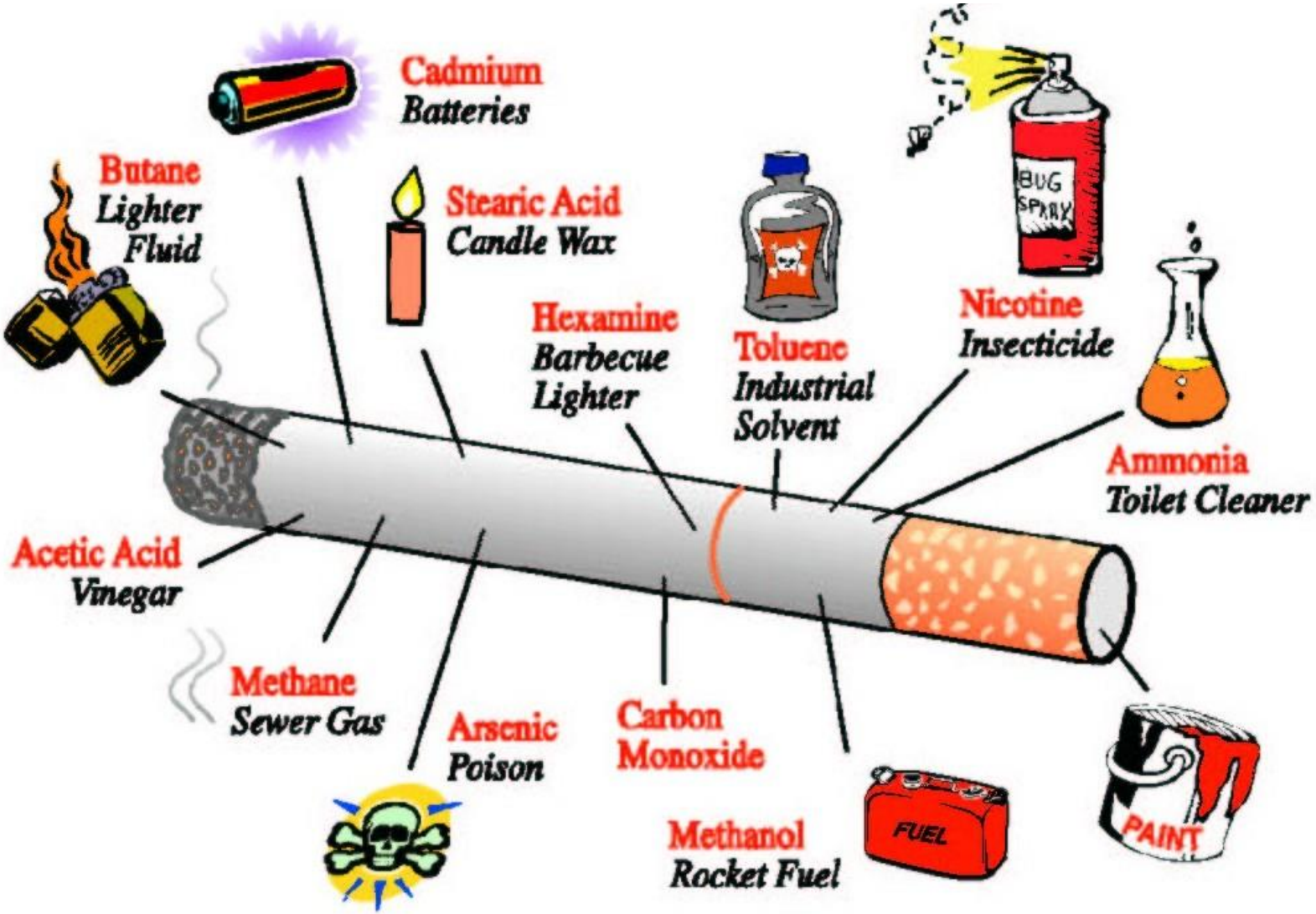
American Cancer Society

What in tobacco smoke is harmful?

US Food & Drug Administration

Constituents in tobacco?

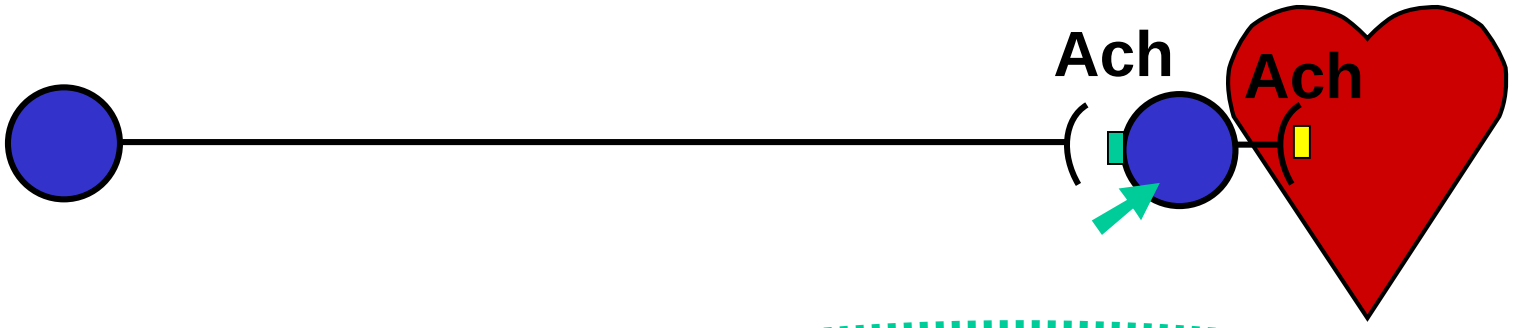
http://pmep.cce.cornell.edu/profiles/



http://livealittlelonger.wordpress.com/tobacco/whats-inside-that-cigarette/

http://www.smokefree.gov/

Parasympathetic

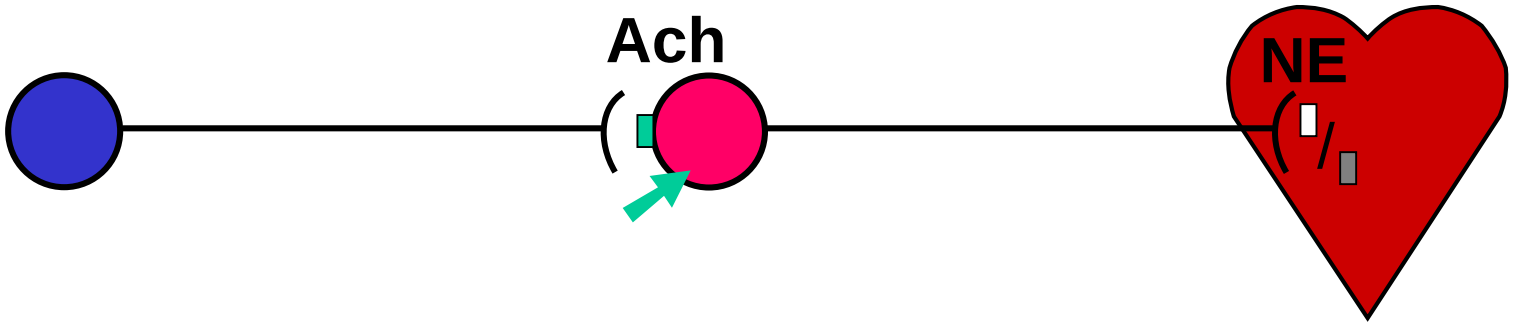


Ach = Acetylcholine

= Nicotinic Receptor

= Muscarinic Receptor

Sympathetic



NE = Norepinephrine

= α Receptor (α_1 , α_2)

= β Receptor (β_1 , β_2)

TOBACCO ADDITIVES

The tobacco industry has acknowledged that nearly 600 chemicals are added to cigarettes. It is not clear, however, how much of the various additives are used or which combinations appear together. Some of the chemicals among cigarette additives most questioned by tobacco opponents include:

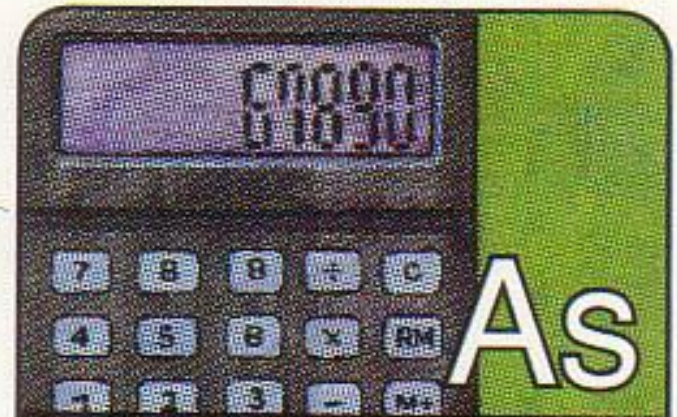
- **Megastigmatrienone:** A flavoring that tobacco companies contend is found naturally in grapefruit juice.
- **Dehydromenthofurolactone:** A flavoring that tobacco companies say is found in peppermint.
- **Ethyl furoate:** Found naturally in coffee, kiwi and peanuts.
- **Maltitol:** A sweetener used in chewing gum and diabetic candy.
- **Sclareolide:** A synthetic form of a naturally occurring tobacco element.
- **Ammonia:** A processing aid.
- **Methoprene:** An insecticide that toxicologists say is biodegradable.
- **Other additives:** Yeast, wine, caffeine, beeswax, beta carotene, chocolate, coconut oil.

freebase nicotine!!

Ammonia converts nicotine, the additive agent in tobacco, into a more volatile form, Pankow said. “Ammonia is the thing that helps tobacco companies hook the smoker by providing a means of delivering the nicotine.”

Last October, a former tobacco industry employee revealed that secret industry documents indicated that ammonia was added to tobacco to double the impact of nicotine. Research now indicates that ammonia can boost nicotine availability up to 100x! The Oregon Graduate Institute (now a part of OHSU) was the 1st to research!

http://pubs.acs.org/doi/abs/10.1021/es970402f
http://www.nasw.org/users/sperkins/nicotine.html

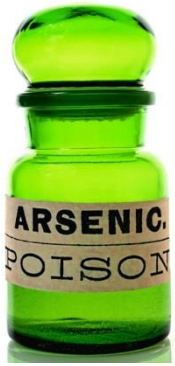


Arsenic 33

- o Shotgun pellets
- \+ Metal for mirrors
- v Glass, lasers
- **v Light emitting diodes=LED**
- x 74.9216

Polonium 84

- o **Nuclear batteries**
- o Neutron source
- o Antistatic agents
- o Film cleaner
- x (209)



Tobacco-free Campus

For better health, smoking and use of tobacco products are prohibited everywhere on our property.

SMOKE AND TOBACCO-FREE UNIVERSITY

September 1, 2012

For a healthier community and cleaner environment, the University of Oregon will be smoke and tobacco free

Ready to Quit Tobacco?

tobaccofree.uoregon.edu

For a healthier community and cleaner environment, the University of Oregon is smoke and tobacco-free.

ScienceNews
MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC

News: Health, Toxicology, Pollution

Health risks of e-cigarettes emerge

Vaping pollutes lungs with toxic chemicals and may even make antibiotic-resistant bacteria harder to kill

By JANET RALOFF 4:31PM, JUNE 3, 2014

https://www.sciencenews.org/article/health-risks-e-cigarettes-emerge

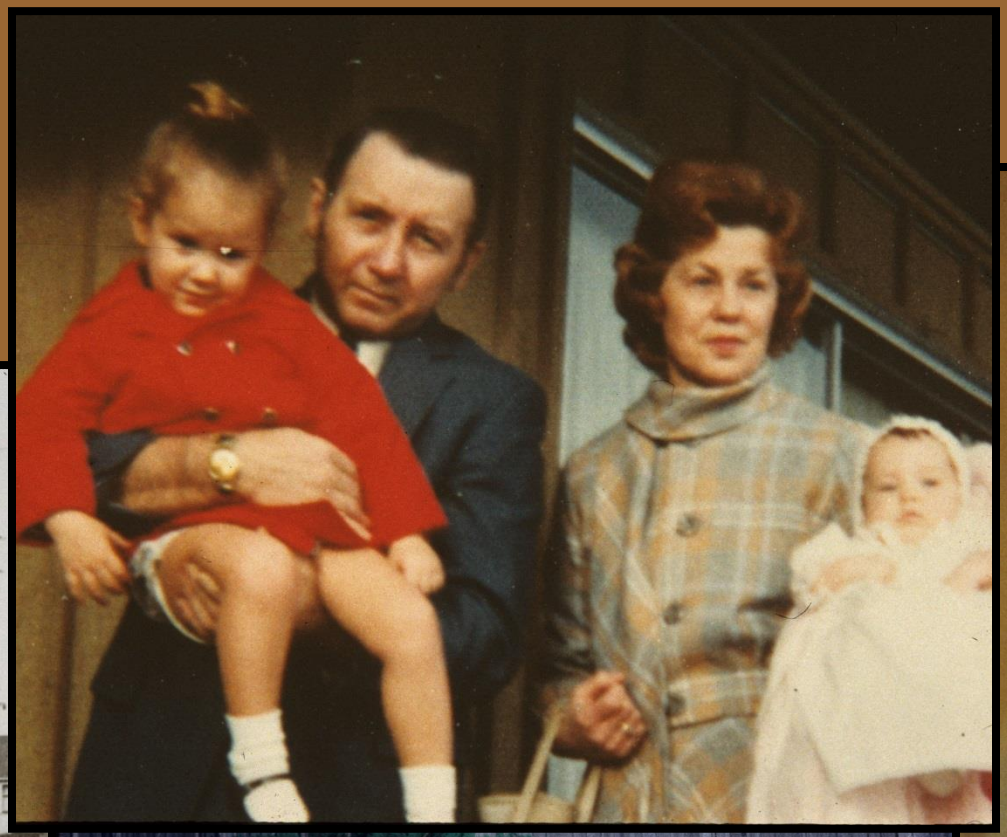
TIME OUT

BREAK!

Dedication to Dr. Eugene Evonuk, 1921-1984
Director, Laboratory of Applied Physiology
University of Oregon, 1967-1984
http://blogs.uoregon.edu/evonuk/


“Never be so narrow
as to lose sight of
the big picture!”

Walking Medical Dictionary, Demanding Mentor with Unending Dedication & Love for His Students & Family



Infectious Curiosity & Love for Life & the Outdoor World!

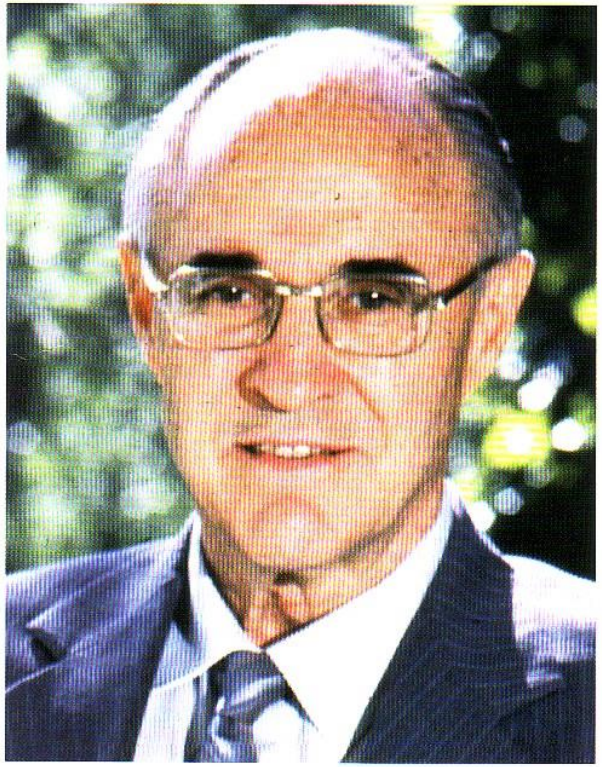
Gene, we can always get another plane!

In Memoriam

Arthur C. Guyton, MD
(1919–2003)

The sudden loss of Dr Arthur C. Guyton in an automobile accident on April 3, 2003 and the loss of his devoted and remarkable wife, Ruth Weigle Guyton, one week later as a result of injuries from the accident stunned and saddened all who were privileged to know them. Arthur Guyton was a giant in the fields of physiology and medicine, a leader among leaders, a master teacher, and an inspiring role model for people throughout the world.

Arthur Clifton Guyton was born in Oxford, Mississippi, to Dr William (Billy) S. Guyton, an eye, ear, nose, and throat specialist and dean of the University of Mississippi Medical School, and Kate Smallwood Guyton, a math and physics teacher who had been a missionary in China before their marriage. During his formative years, he enjoyed watching his father work at the Guyton Clinic, playing chess and swapping stories with William Faulkner, and building sailboats (one of which he later sold to Faulkner) and countless mechanical and electrical devices, which he continued to do throughout his life. Arthur Guyton's brilliance shone early. He graduated top in



inventions he received a Presidential Citation. He returned to Oxford where he devoted himself to teaching and research at the University of Mississippi School of Medicine and was named chair of the Department of Physiology in 1948. In 1951 he was named one of the 10 outstanding men in the nation. When the University of Mississippi moved its medical school to Jackson in 1955, he rapidly developed one of the world's premier cardiovascular research programs. His remarkable life as a scientist, author, and devoted father is detailed in a biography published on the occasion of his "retirement" in 1989.[1]

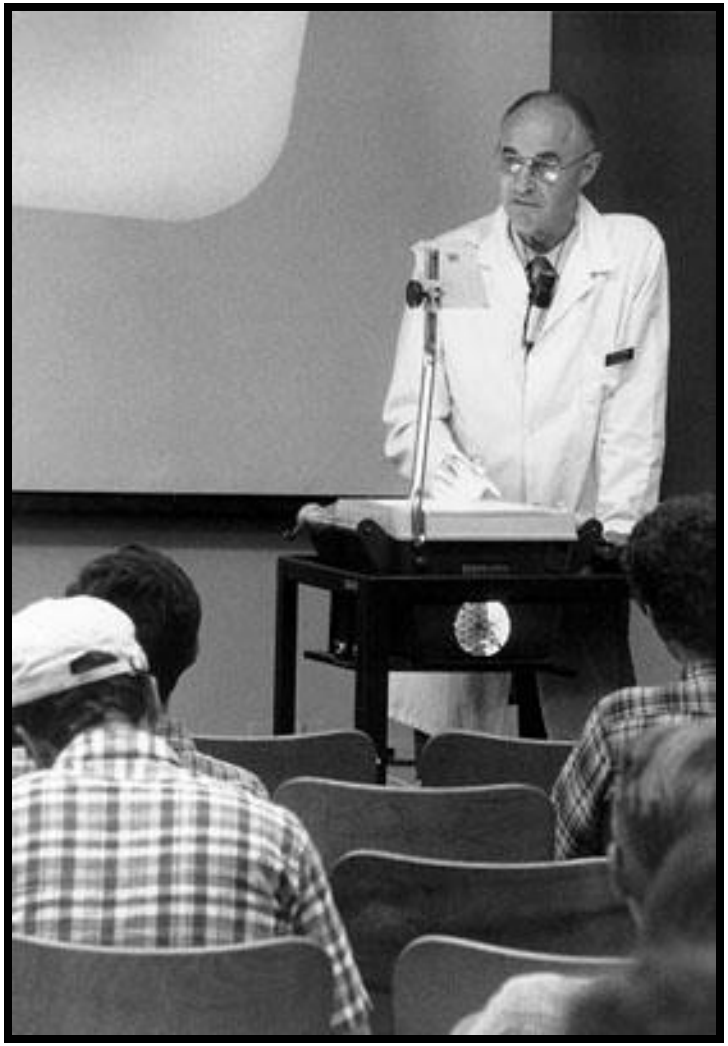
A Great Scientist

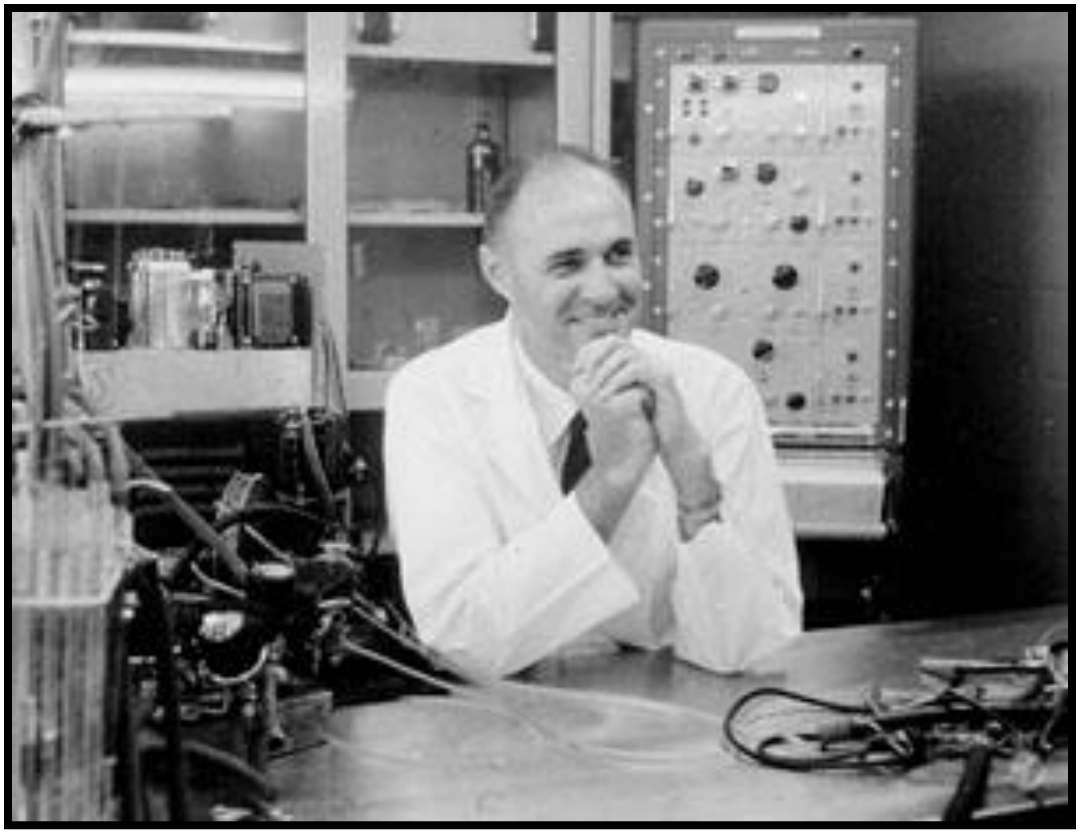
Arthur Guyton's research contributions, which include more than 600 papers and 40 books, are legendary and place him among the greatest figures in the history of cardiovascular research. His research covered virtually all areas of cardiovascular regulation and led to many seminal concepts that are now an integral part of our understanding cardiovascular physiology and disorders such as hypertension, heart failure, and edema. It is difficult to discuss cardiovascular

G&H 11th ed
pp vi-ix

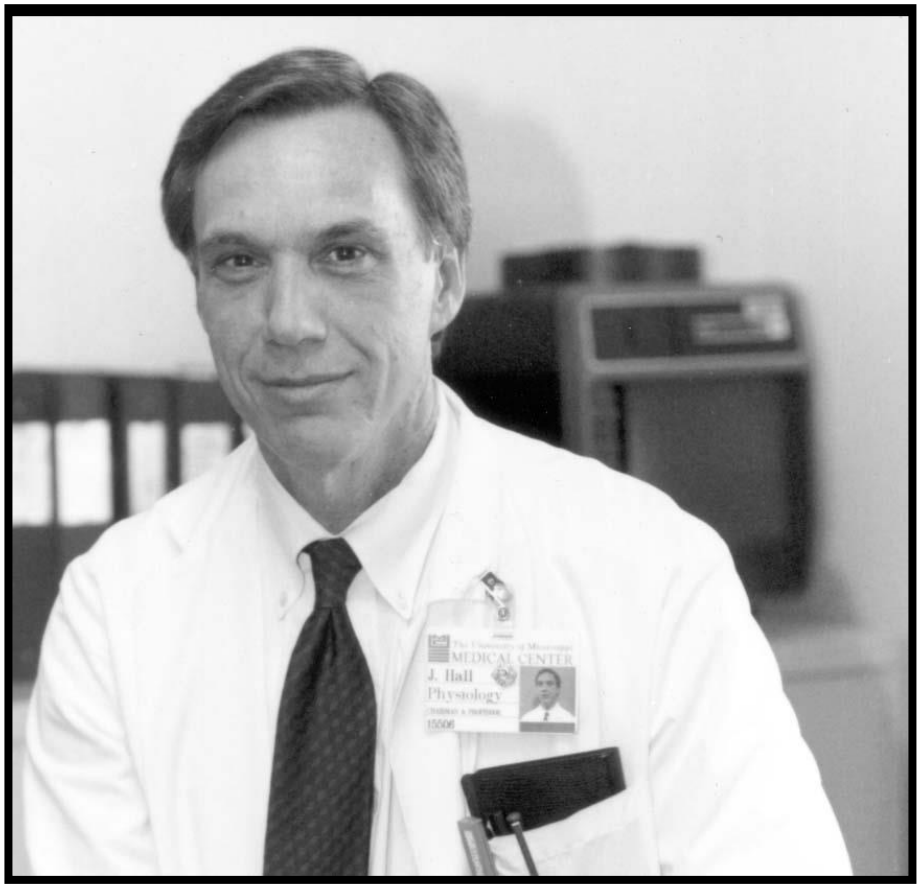
http://hyper.ahajournals.org/cgi/content/full/41/6/1175

Dr. Guyton Teaching & in the Lab





https://www.umc.edu/About_Us/History/Dr__Arthur_Guyton.aspx



John E. Hall, PhD
Arthur C. Guyton Professor & Chair
Department of Physiology & Biophysics
University of Mississippi Medical Center
Jackson, Mississippi

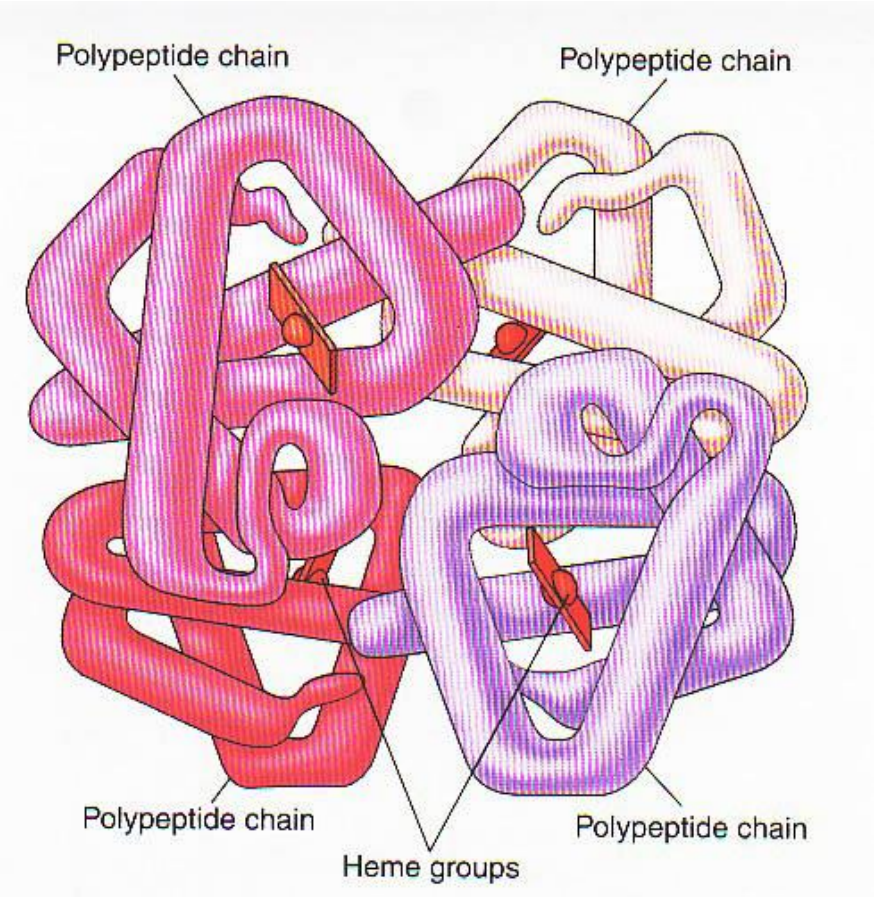
https://www.umc.edu/Education/Schools/Medicine/Basic_Science/Physiology_and_Biophysics/John_E__Hall,_PhD.aspx

Discussion/Questions?

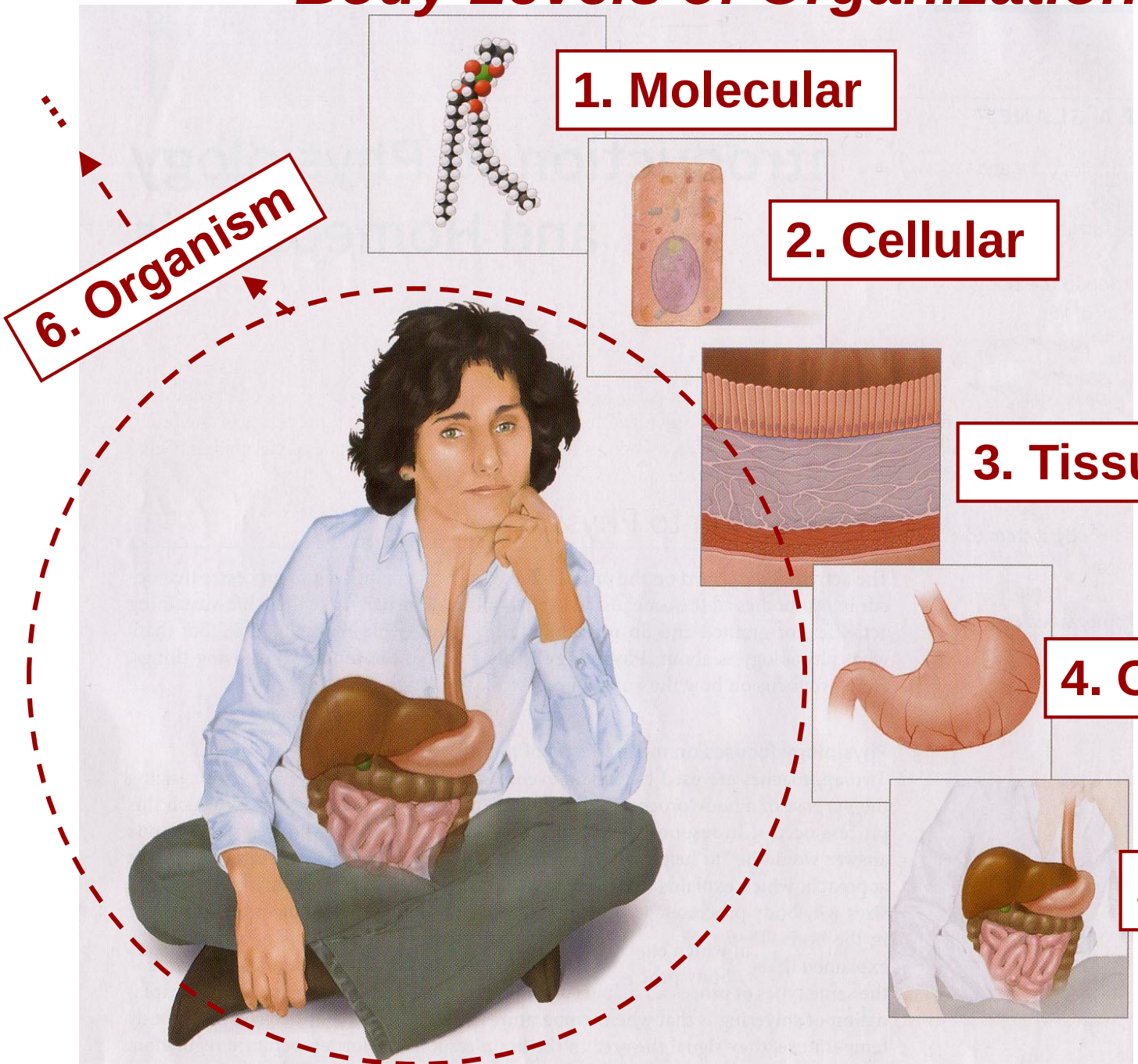
ANATOMY	vs	PHYSIOLOGY
STRUCTURE	vs	FUNCTION
WHAT?	vs	HOW?
WHERE?	vs	WHY?

vs

Structure* begets *function!
Structure* gives rise to *function!
***Structure & function* are inseparable!**



Body Levels of Organization



LS 2012 fig 1-1 p 2

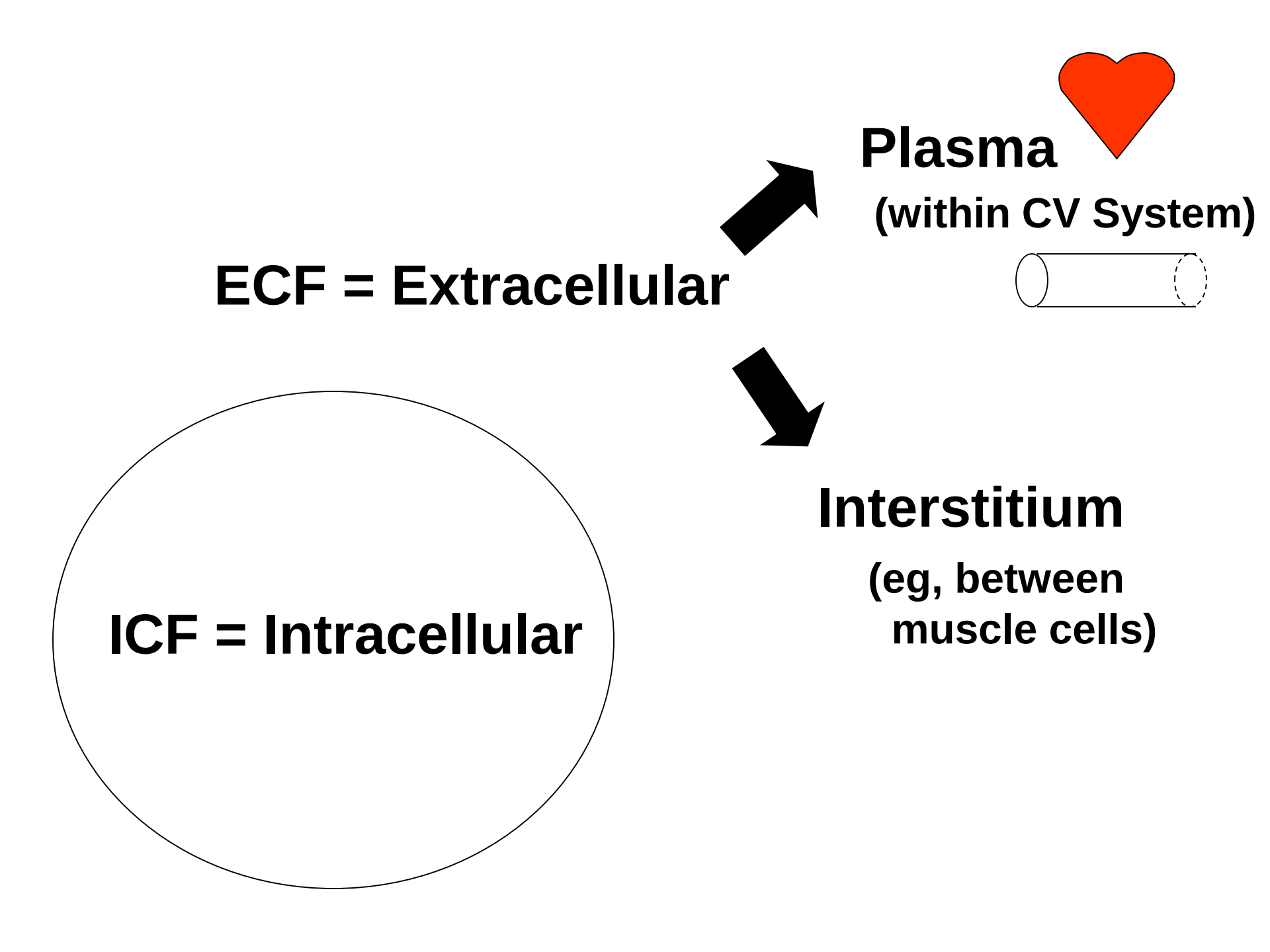
Maintenance of a relative constancy in the Internal environment = ECF = fluid outside of cells

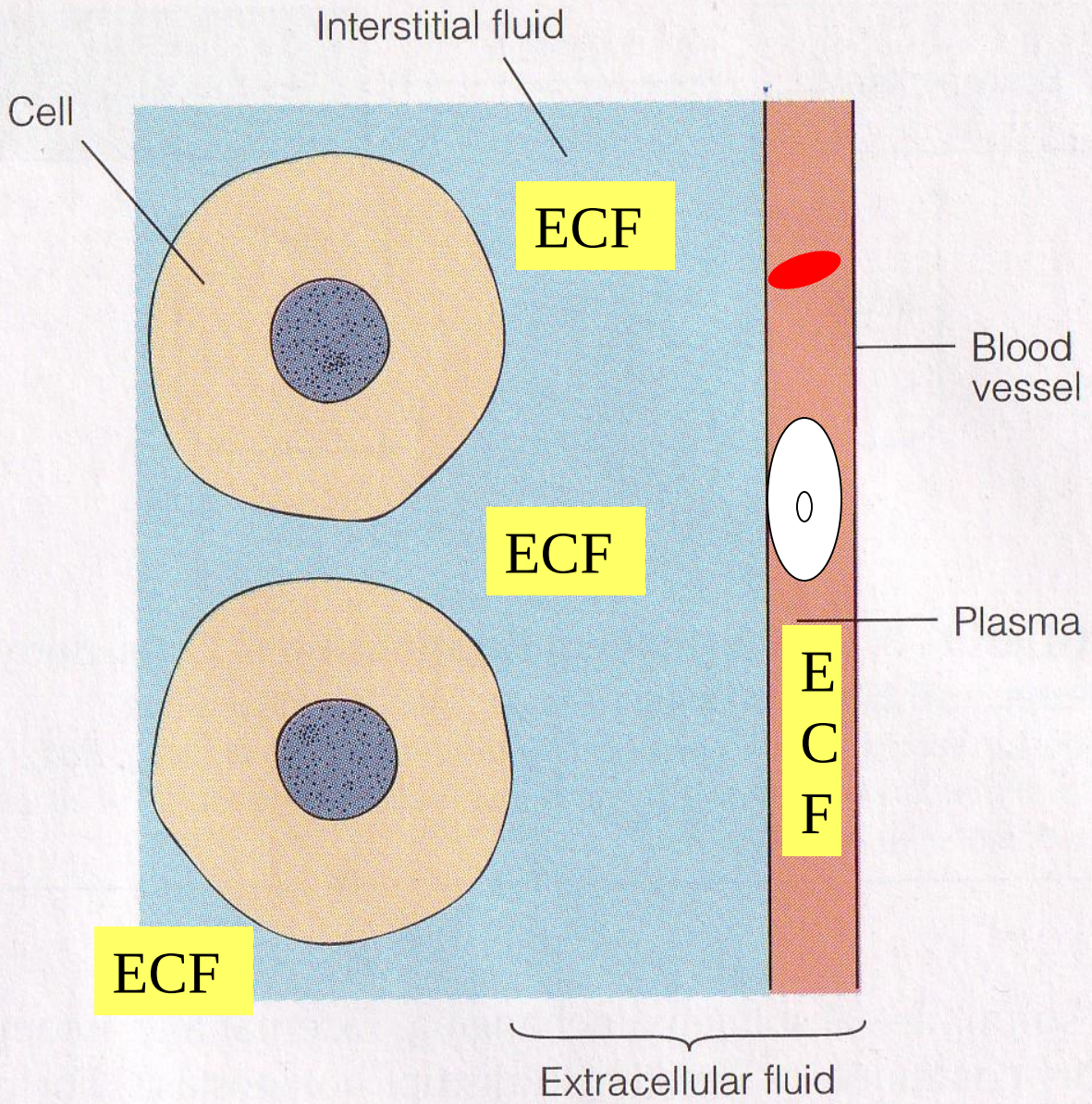
milieu interieur?

Claude Bernard

100 trillion cells working intimately

Walter B. Cannon

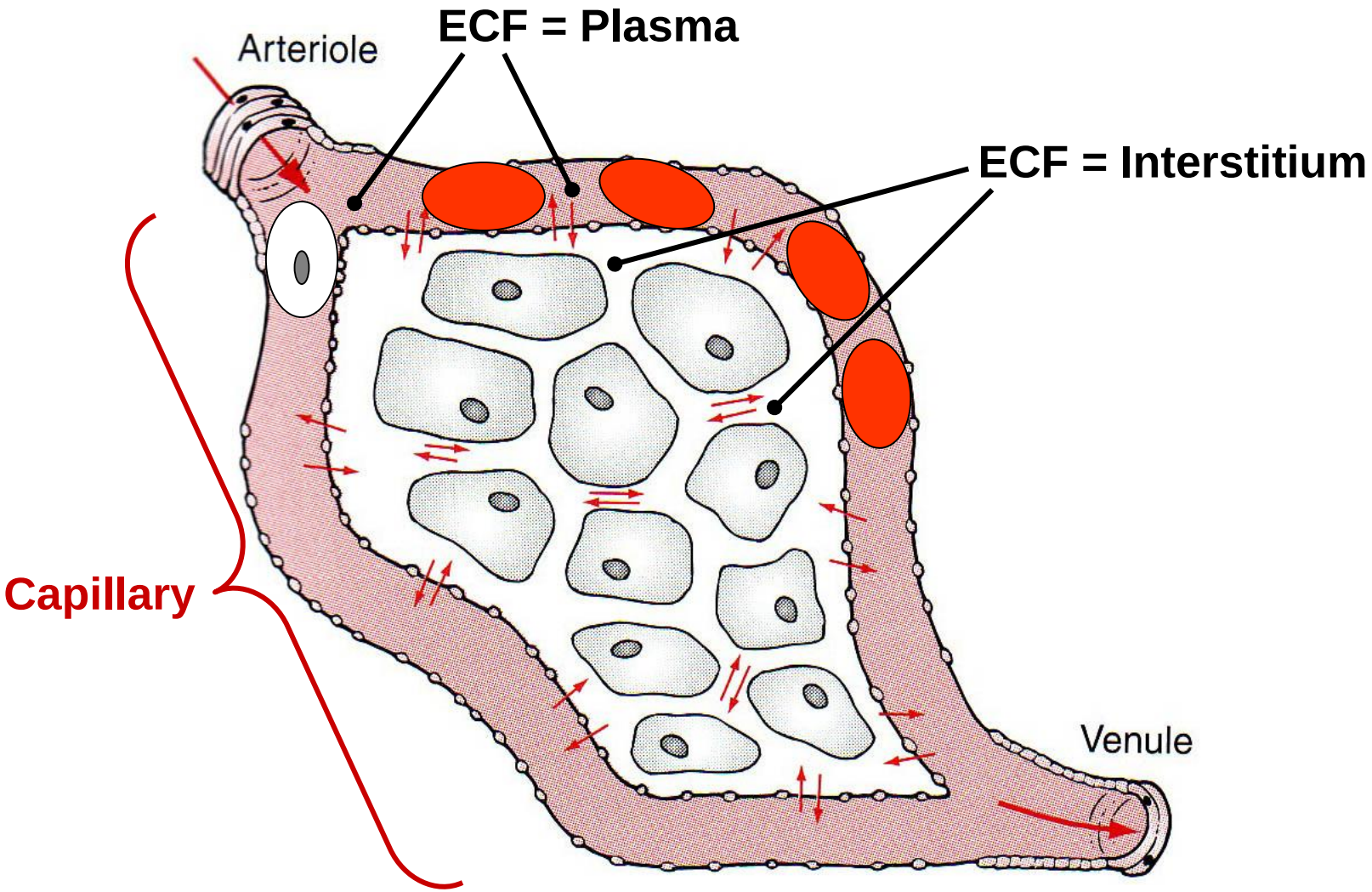

Plasma
(within CV System)
ECF = Extracellular
Interstitium
(eg, between
muscle cells)
ICF = Intracellular



▶FIGURE 1–2 Components of the Extracellular Fluid (Internal Environment)

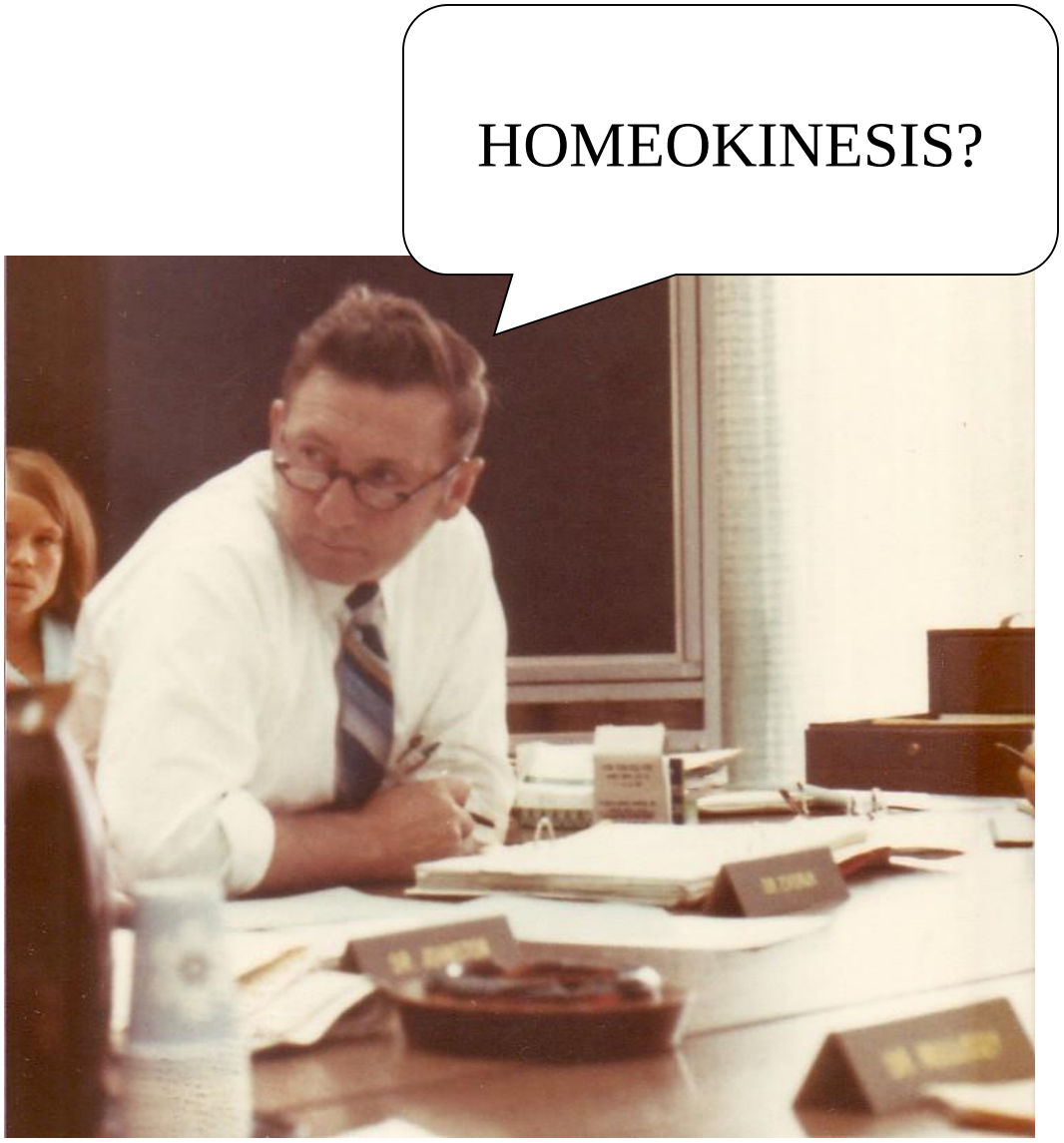
LS 2006 fig 1-4 p 8

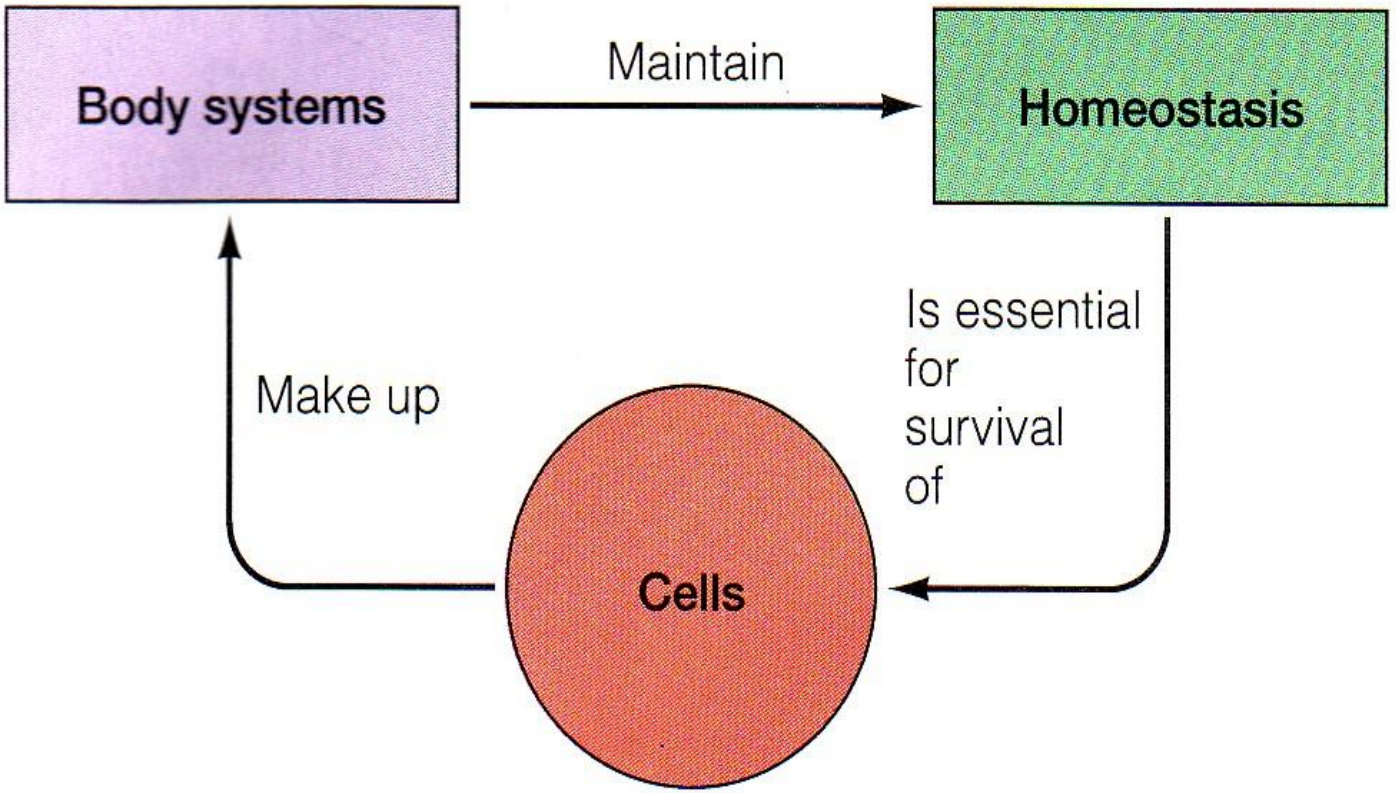
Where is extracellular fluid (ECF)?



As long as <u>between/outside</u> cells, ECF everywhere!

Plasma and Interstitium mix/mingle @ Capillary.

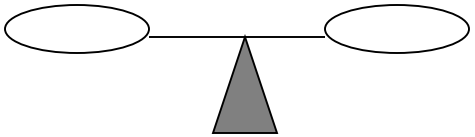

HOMEOKINESIS?



▶ FIGURE 1–3 Interdependent Relationship of Cells, Body Systems, and Homeostasis The depicted interdependent relationship serves as the foundation for modern-day physiology: *Body systems maintain homeostasis, homeostasis is essential for survival of cells, and cells make up body systems.*

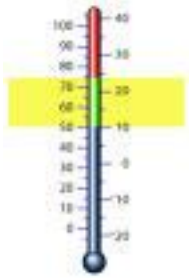
Metabolic

ANA- CATA-



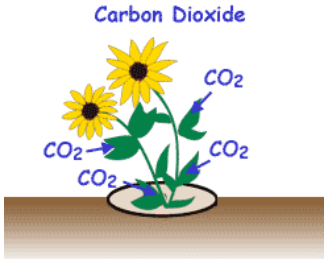
H_2O

T°C



Dr. Evonuk's 6 Balances

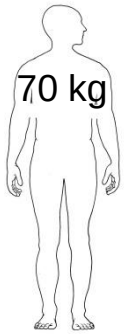
O_2/CO_2



$Ion^{+/-}$

pH

70% H_2O = 49L



eg

ICF = 35L

+

ECF = 14L

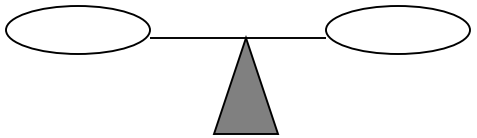
[Interstitium = 11L
Plasma = 3L]

H_2O

INPUT

Dietary Drink	1200 mL
Dietary Eat	400 mL
Oxidation	400 mL
Total =	2000 mL

BALANCE!

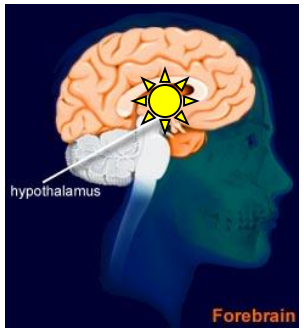


OUTPUT

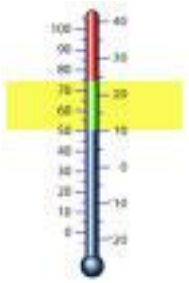
Urine	1000 mL
Sweat + Insensible	900 mL
Feces	100 mL
Total =	2000 mL

DLN A-1, A-2

Controller =
Hypothalamus
with Set Point



ToC



ToC

Lethal

42oC

Protein Denaturation

True Diurnal Variation

110oF

Set Point

37oC

98.6oF

35oC

Mild Hypothermia

Profound Hypothermia

33oC

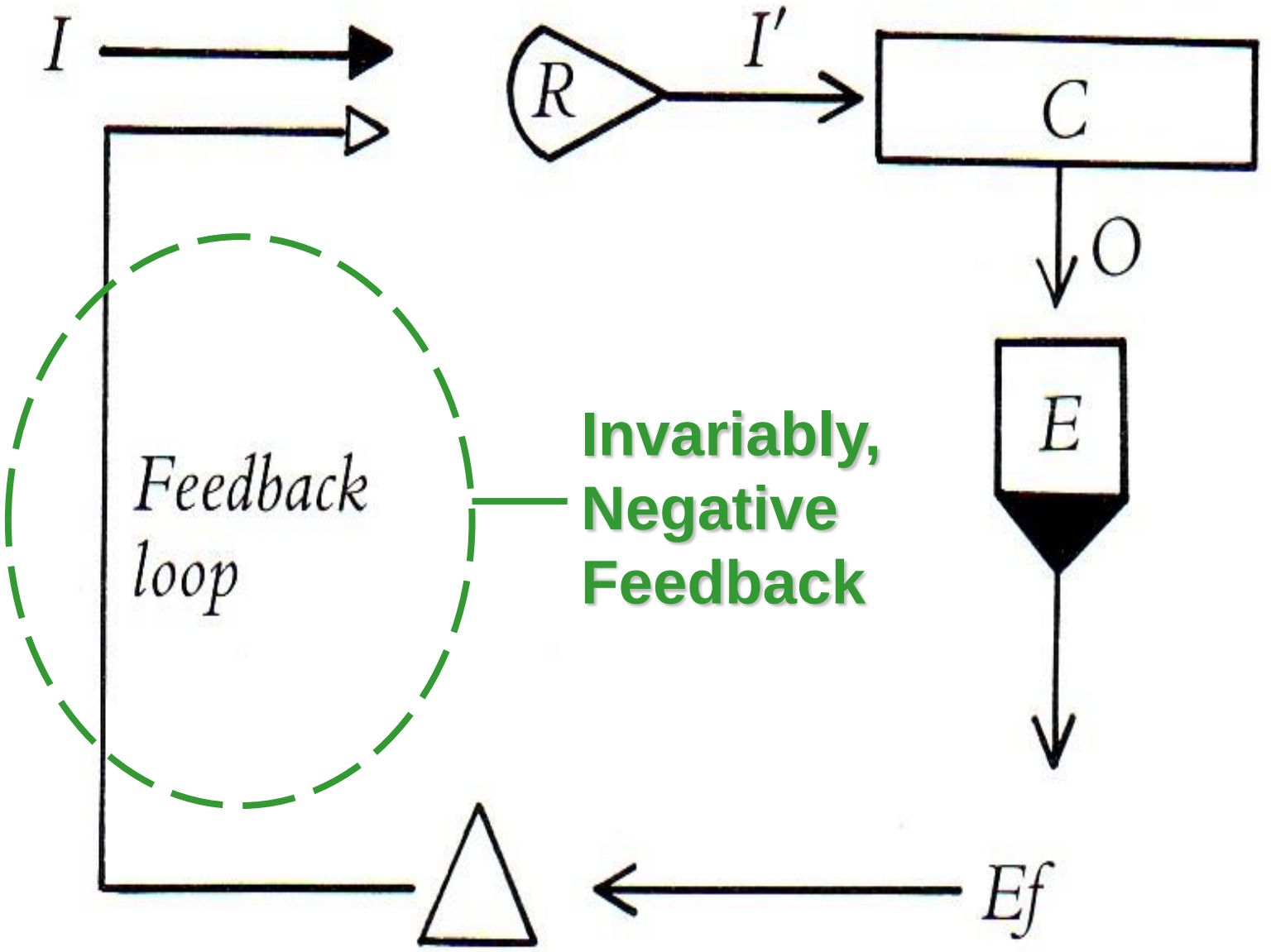
< 30oC

Lethal

29oC

0600 1400 0600 1400

Time of Day


I
R
I′
C
O
E
Feedback loop
Invariably, Negative Feedback
Ef

NB: Though most often negative feedback, there are exceptions:

Selected +FB *e.g.:*

LH Surge → Ovulation
Oxytocin → Uterine Contraction
Blood Clotting Cascade
cAMP Cascade
Na+ influx during AP

Nonpathological! Temporarily amplifies, but ultimately turned off by - FB!

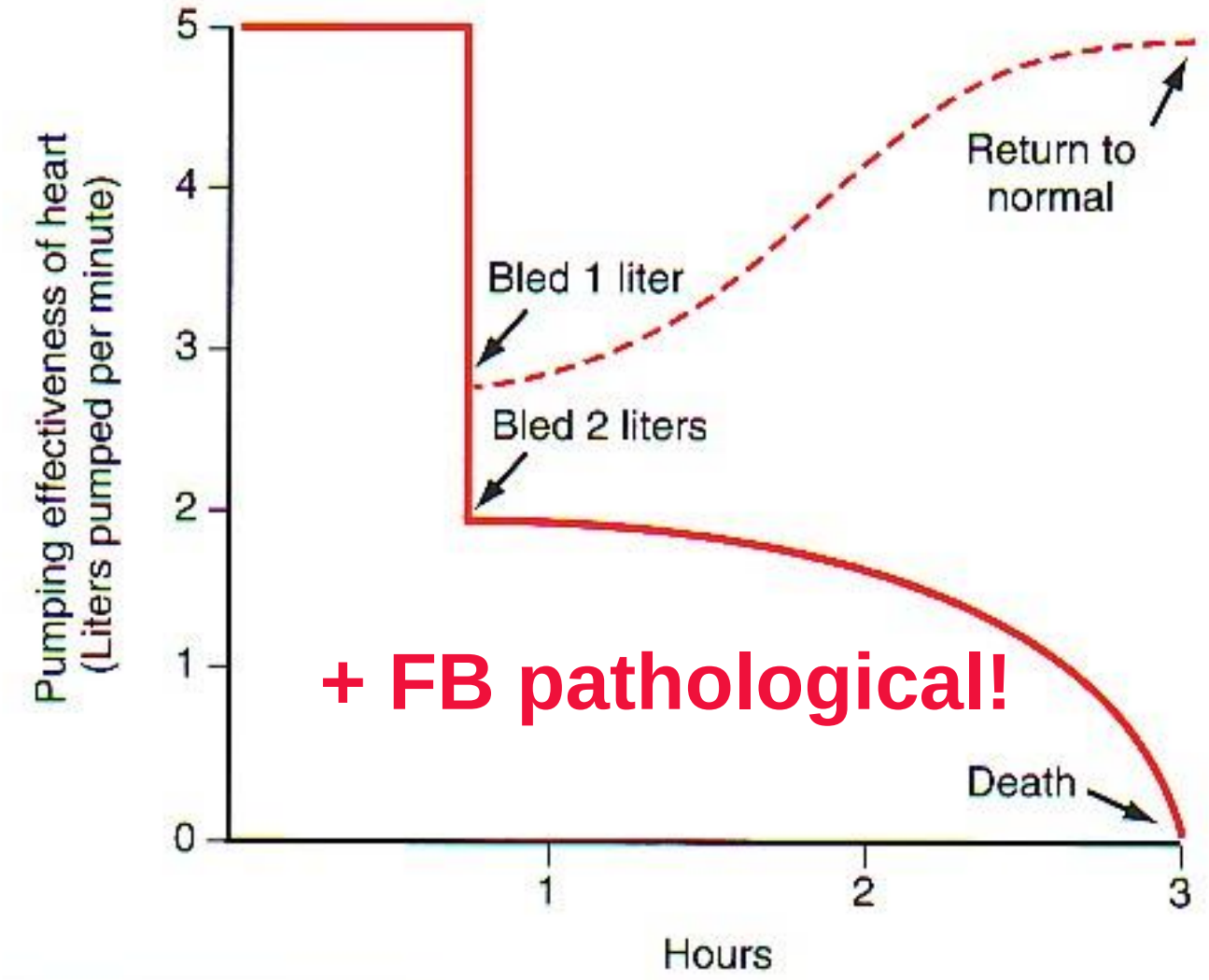
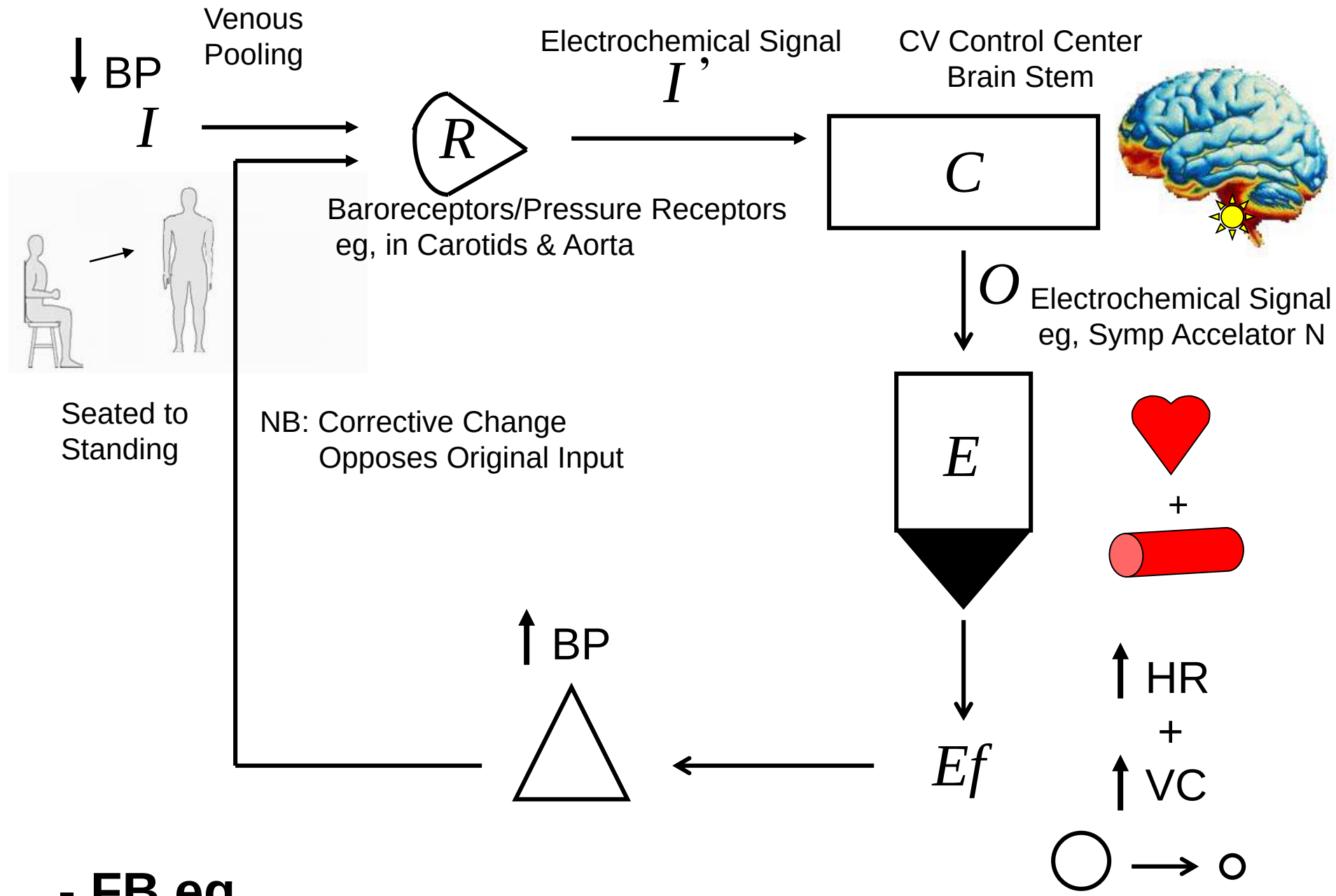


FIGURE 1–3

Recovery of heart pumping caused by *negative feedback* after 1 liter of blood is removed from the circulation. Death caused by positive feedback when 2 liters of blood are removed.


BP
I
Venous Pooling
R
Electrochemical Signal
I'
CV Control Center
Brain Stem
C
Baroreceptors/Pressure Receptors
eg, in Carotids & Aorta
O
Electrochemical Signal
eg, Symp Accelator N
Seated to Standing
NB: Corrective Change
Opposes Original Input
E
+
BP
Ef
HR
+
VC
- FB eg

How Effective is a System at Maintaining Relative Constancy? Feedback Gain*?*

$$\text{Gain} = \frac{\text{Correction}}{\text{Error}}$$

e.g., Transfuse large volume of blood into person with <u>non-functioning</u> Baroreceptor system

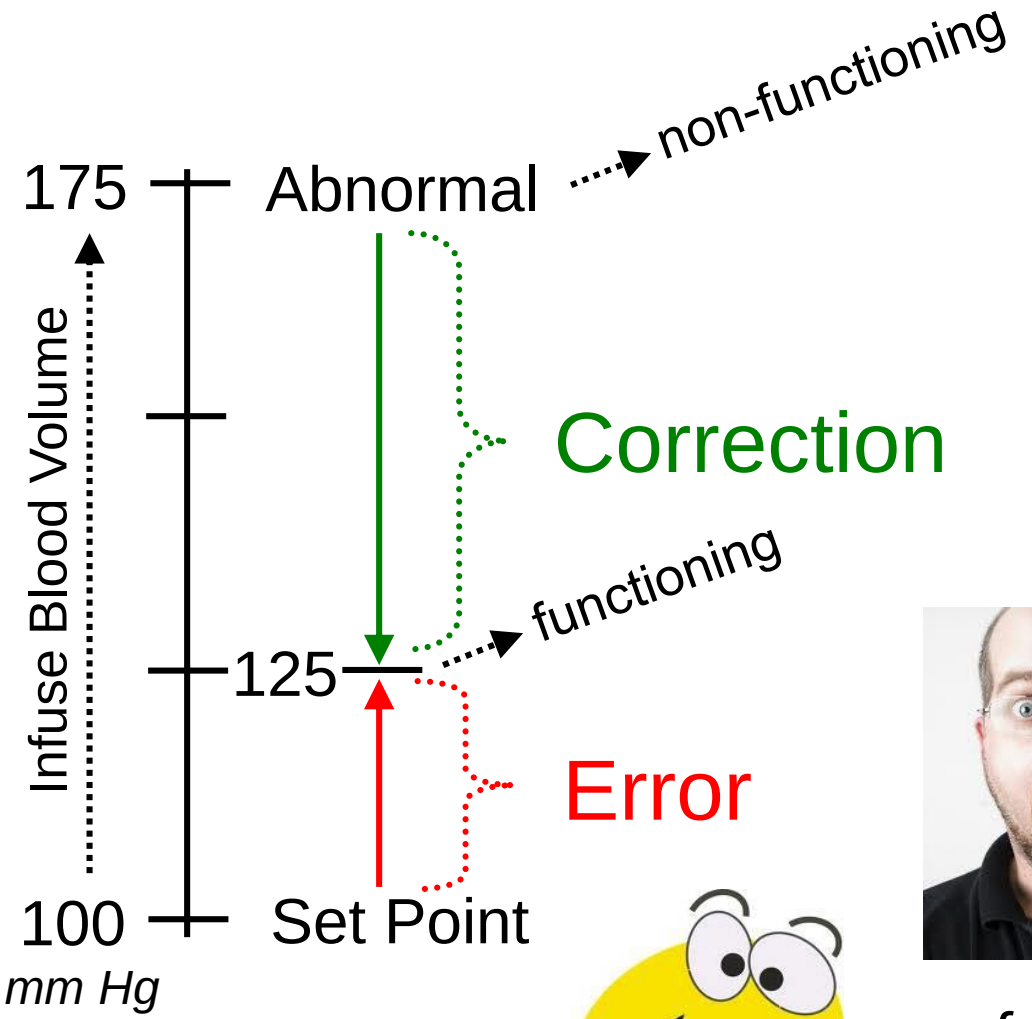
BP: 100 mm Hg → 175 mm Hg

...into person with <u>functioning</u> system

BP: 100 mm Hg → 125 mm Hg

G&H pp 7-8

Gain *for Human Baroreceptor System?*



$$\text{Gain} = \frac{-50\ mm\ Hg}{+25\ mm\ Hg} = -2$$

cf: Gain for Human Body Temperature = -33