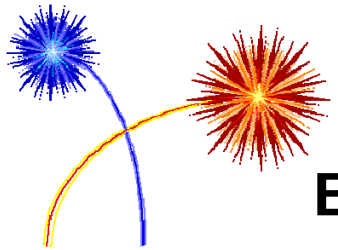


…Douglas Bovee, MD, Internal & Addiction Medicine Specialist. Next Tuesday! Hooray!!

BI 358 Lecture 1- Happy New Year 2014!

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

II. ***Outline Handout*** **Office hr, text, discussion/lecture notebook (DLN), presentation, research paper, optional texts, course format, attendance, expectations, grading, Q?**

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

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

V. ***Body Levels of Organization*** **LS**

VI. ***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

☞☺...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.

Dedication to Dr. Eugene Evonuk, 1921-1984
Director, Laboratory of Applied Physiology
University of Oregon, 1967-1984
http://biology.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!

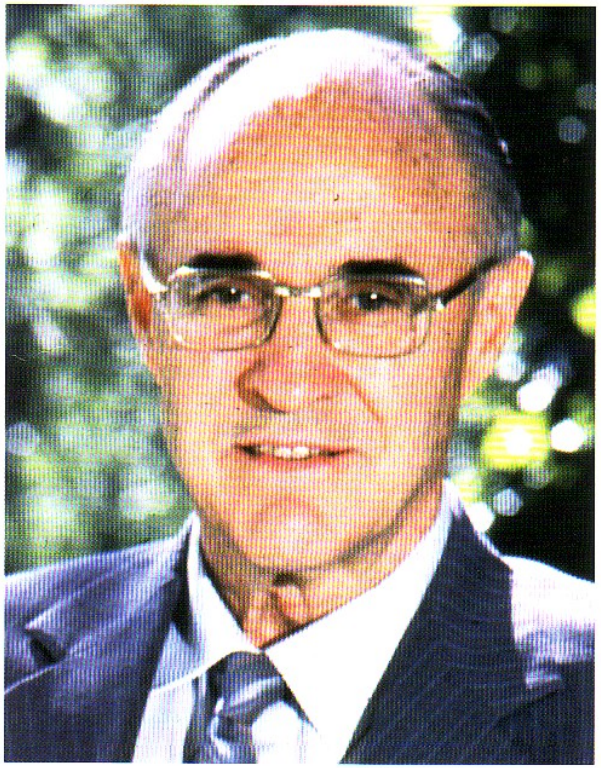
Gene, we can always get another plane!

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]

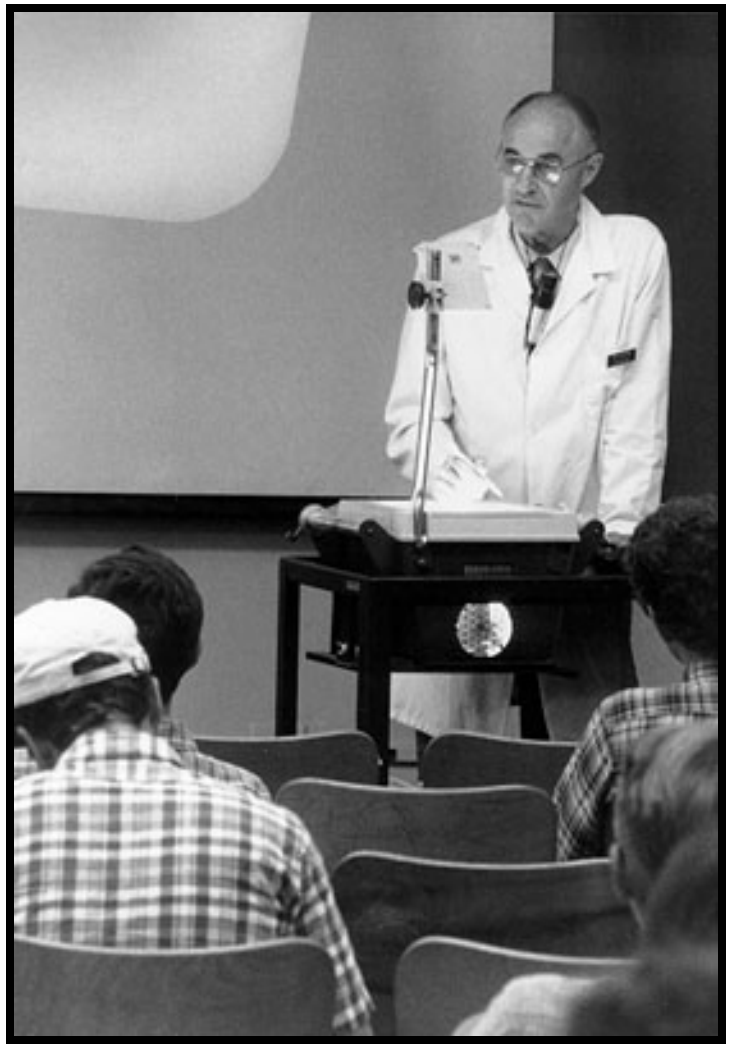
A Great Scientist

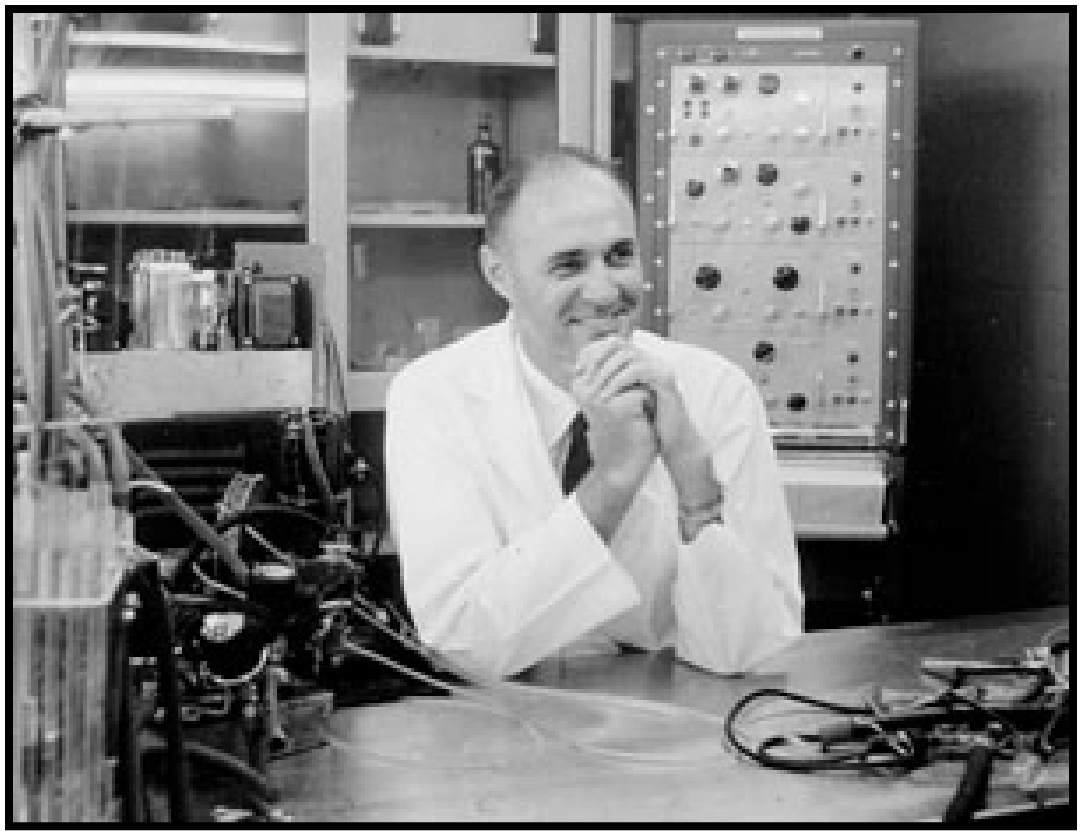
Arthur Guyton's research contributions, which include more than 600 papers and 40 books, are legendary and place him among the greatest figures in the history of cardiovascular research. His research covered virtually all areas of cardiovascular regulation and led to many seminal concepts that are now 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

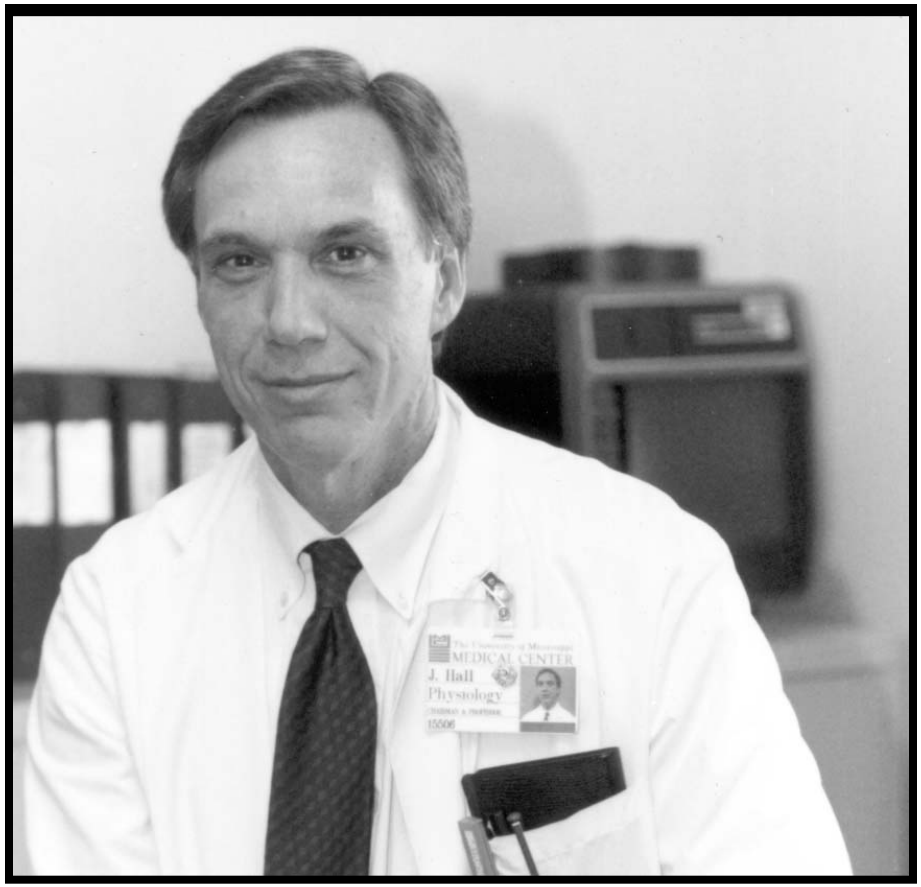
http://hyper.ahajournals.org/cgi/content/full/41/6/1175

Dr. Guyton Teaching & in the Lab





http://www.umc.edu/Dr__Arthur_Guyton.aspx

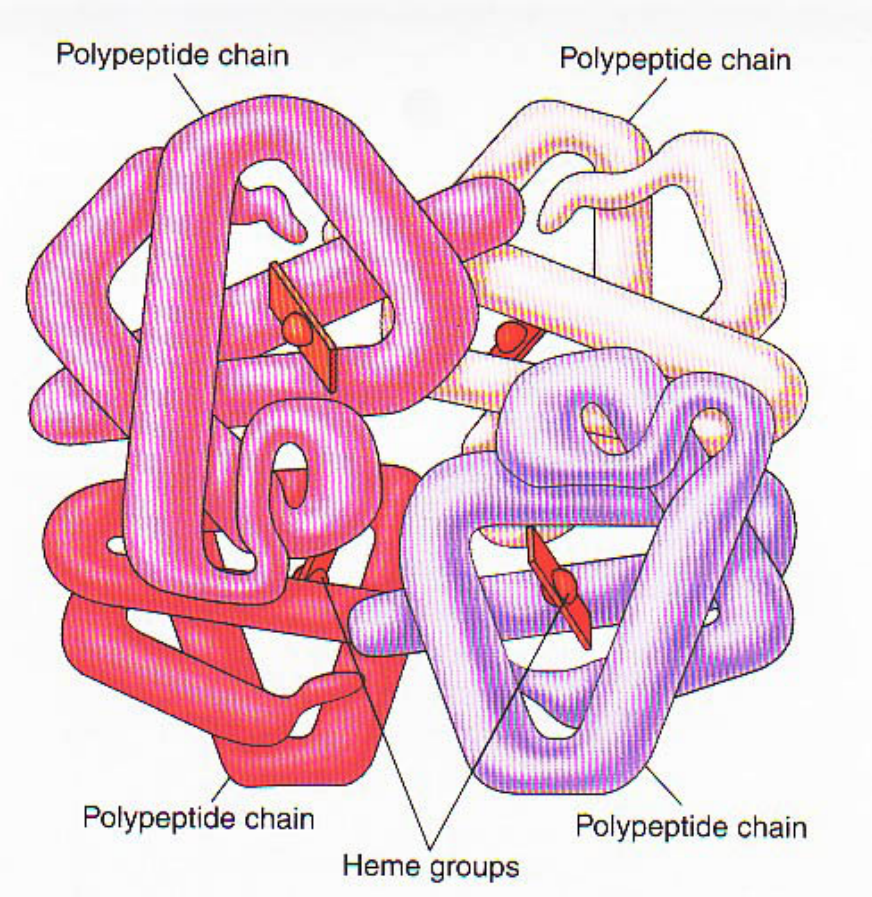


John E. Hall, PhD
Arthur C. Guyton Professor & Chair
Department of Physiology & Biophysics
University of Mississippi Medical Center
Jackson, Mississippi

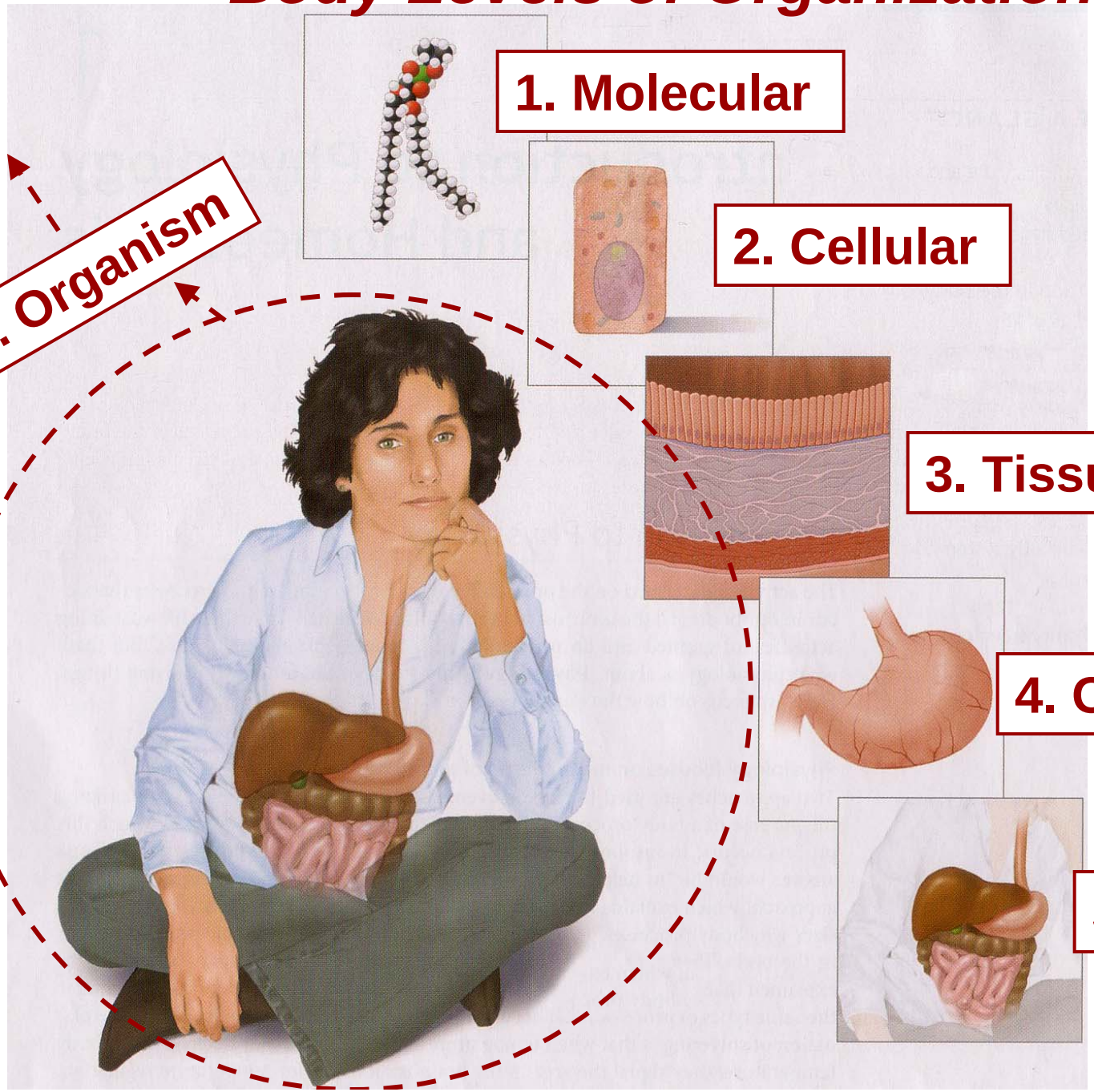
ANATOMY	vs	PHYSIOLOGY
STRUCTURE	vs	FUNCTION
WHAT?	vs	HOW?
WHERE?	vs	WHY?

vs

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



Body Levels of Organization

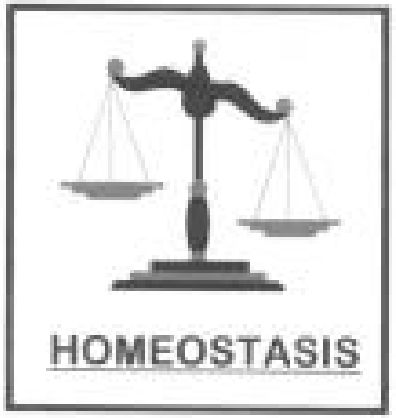


LS 2012 fig 1-1 p 2

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

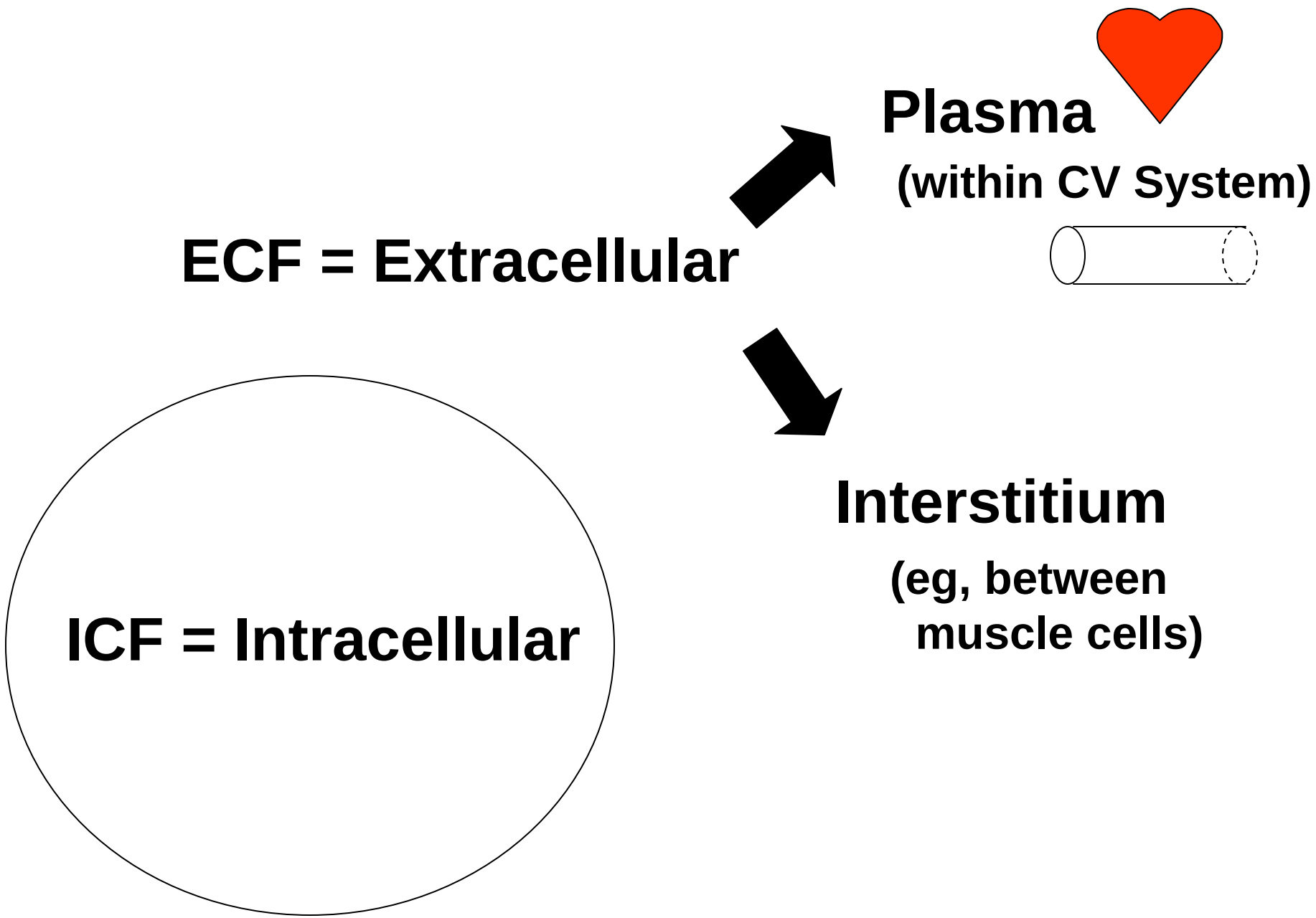
milieu interieur?

Claude Bernard



100 trillion cells working intimately

Walter B. Cannon


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

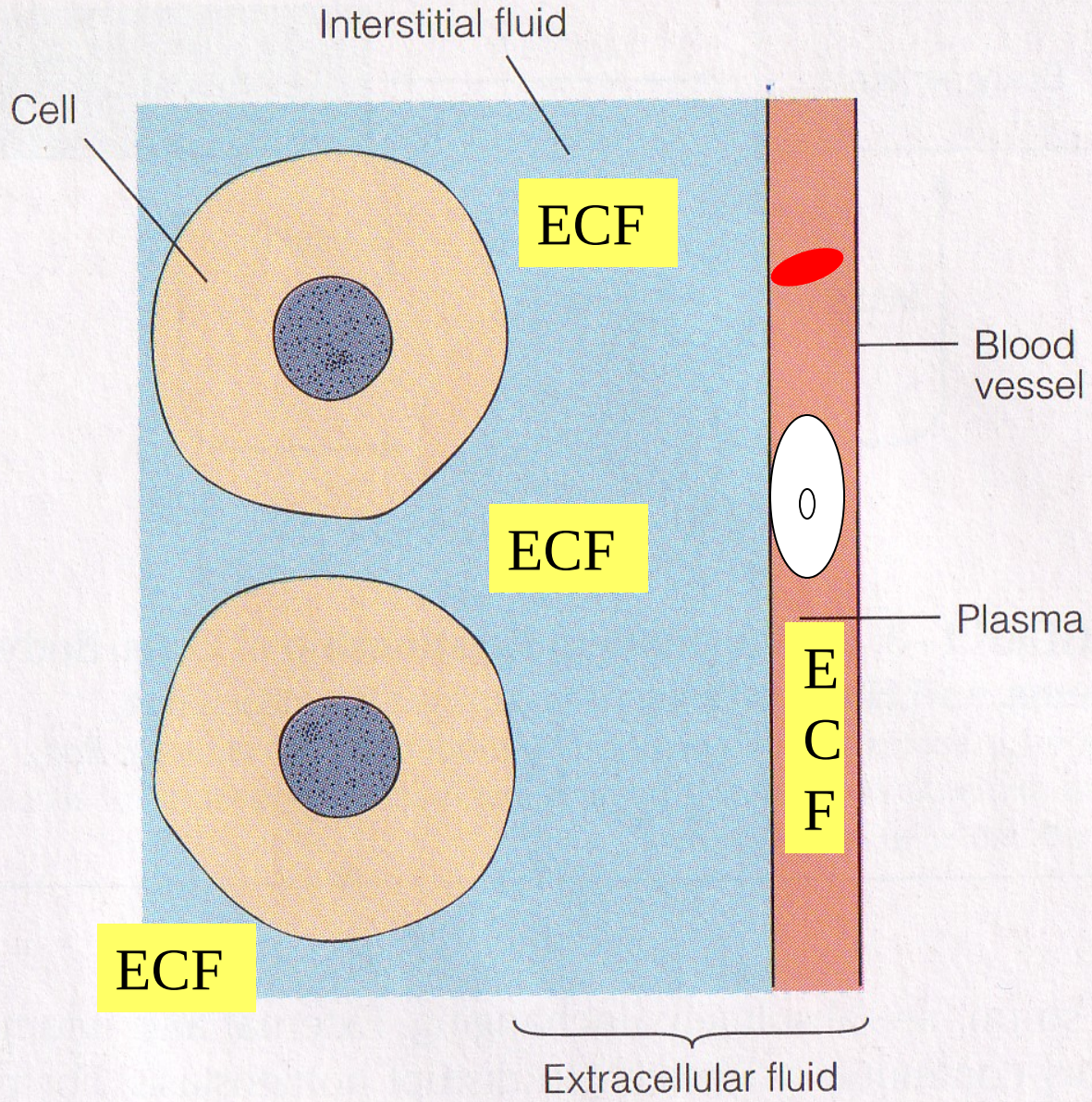
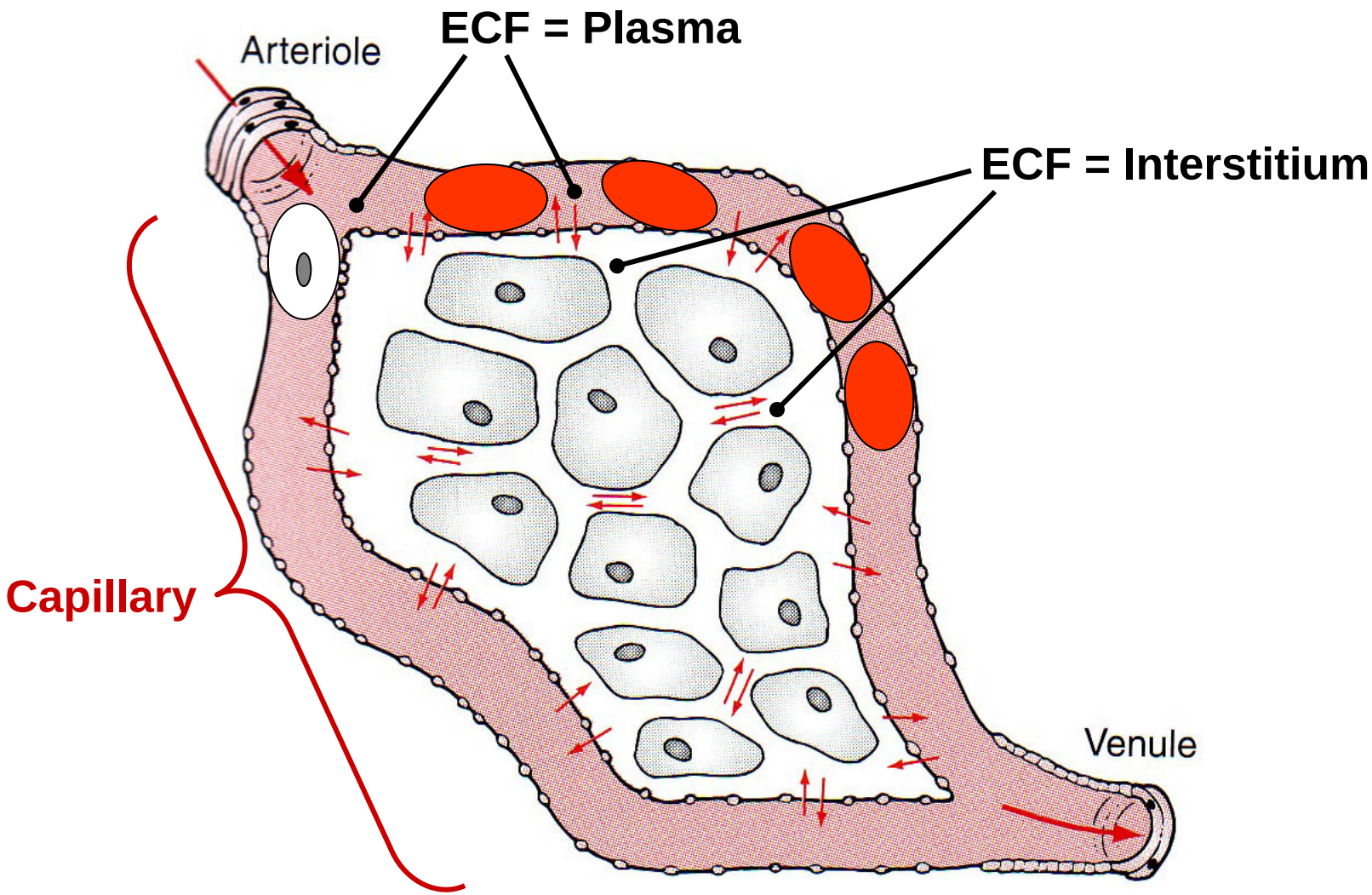


FIGURE 1–2 Components of the Extracellular Fluid (Internal Environment)

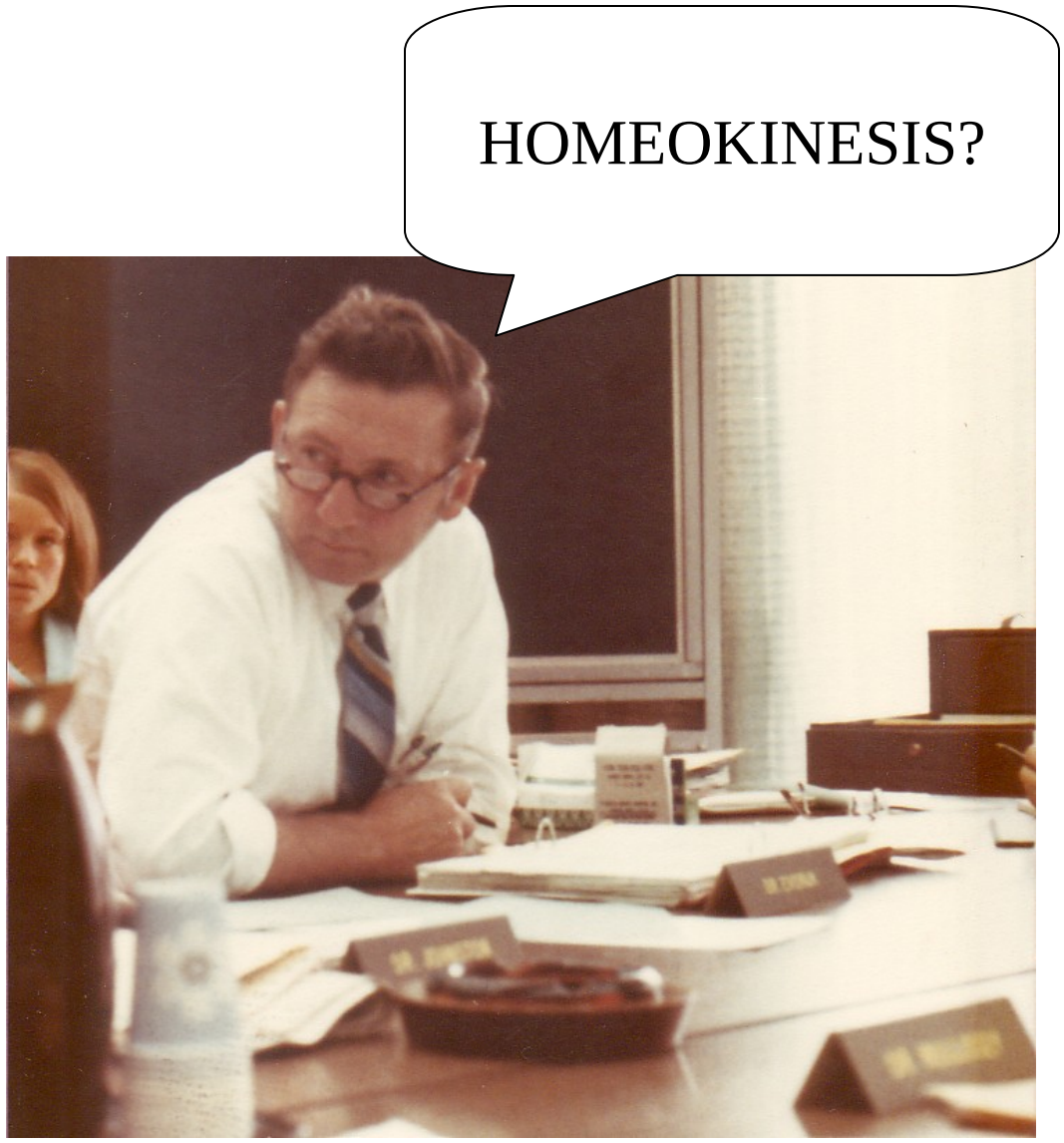
LS 2006 fig 1-4 p 8

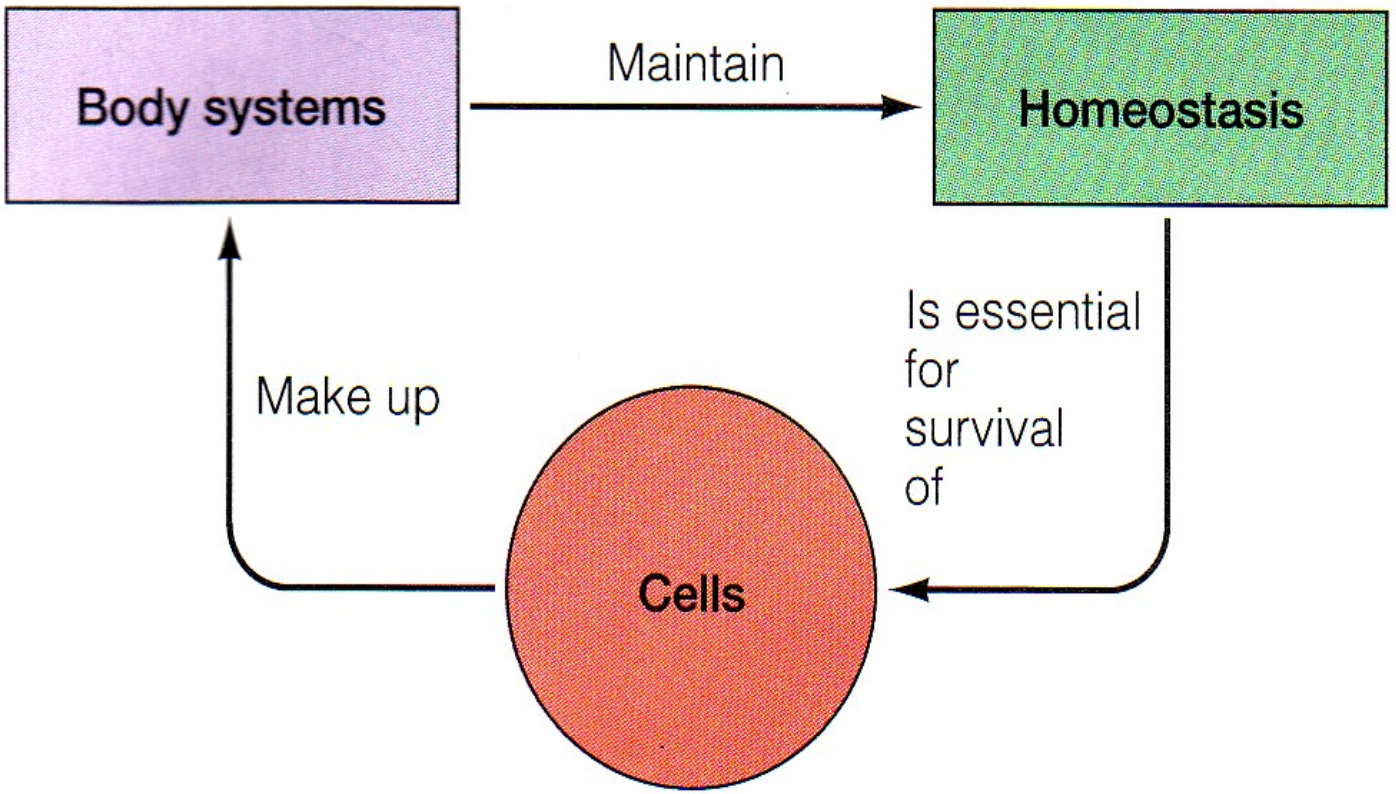
Where is extracellular fluid (ECF)?



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

Plasma and Interstitium mix/mingle @ Capillary.


HOMEOKINESIS?



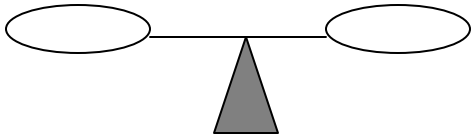
▶ FIGURE 1–3 Interdependent Relationship of Cells, Body Systems, and Homeostasis The depicted interdependent relationship serves as the foundation for modern-day physiology: *Body systems maintain homeostasis, homeostasis is essential for survival of cells, and cells make up body systems.*

LS 1995 fig 1-3 p 6

Dr. Evonuk's 6 Balances

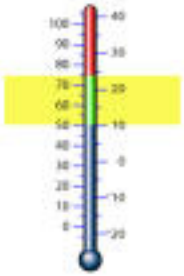
Metabolic

ANA- CATA-

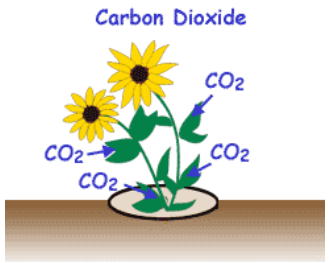


H_2O

T°C

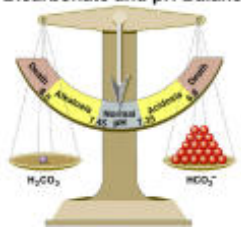


O_2/CO_2



$Ion^{+/-}$

pH



70% H_2O = 49L

eg

ICF = 35L

+

ECF = 14L

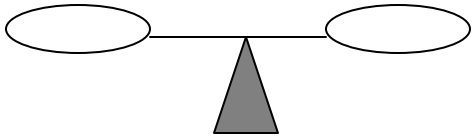
[Interstitium = 11L
Plasma = 3L]

H_2O

INPUT

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

BALANCE!

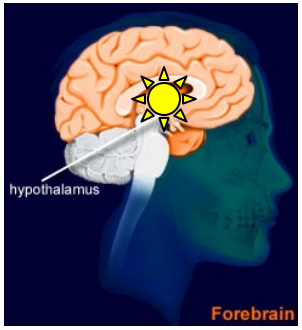


OUTPUT

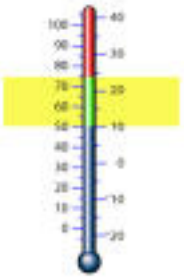
Urine	1000 mL
Sweat + Insensible	900 mL
Feces	100 mL
Total =	2000 mL ✓

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

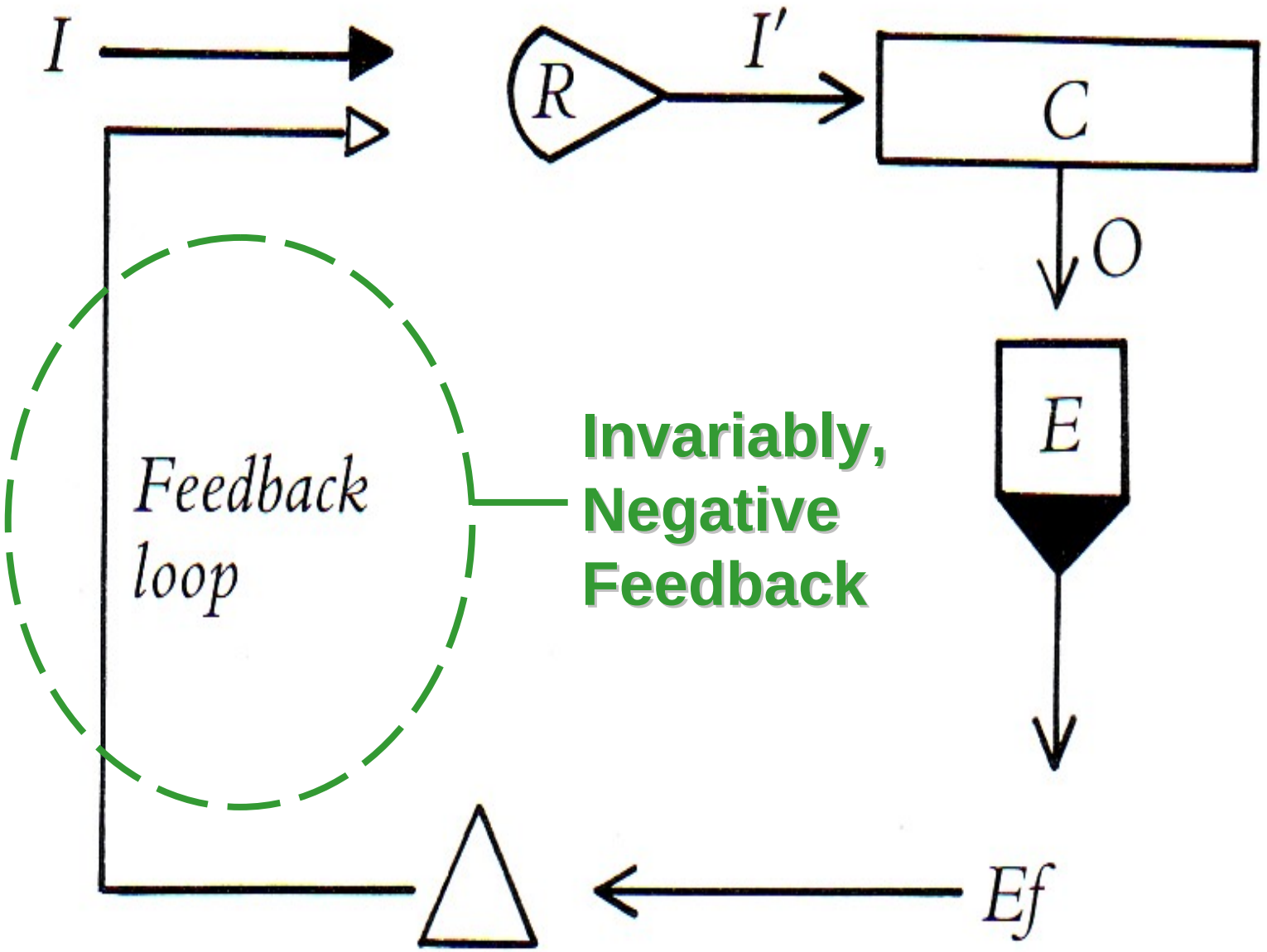
< 30oC

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 eg:

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

Nonpathological!

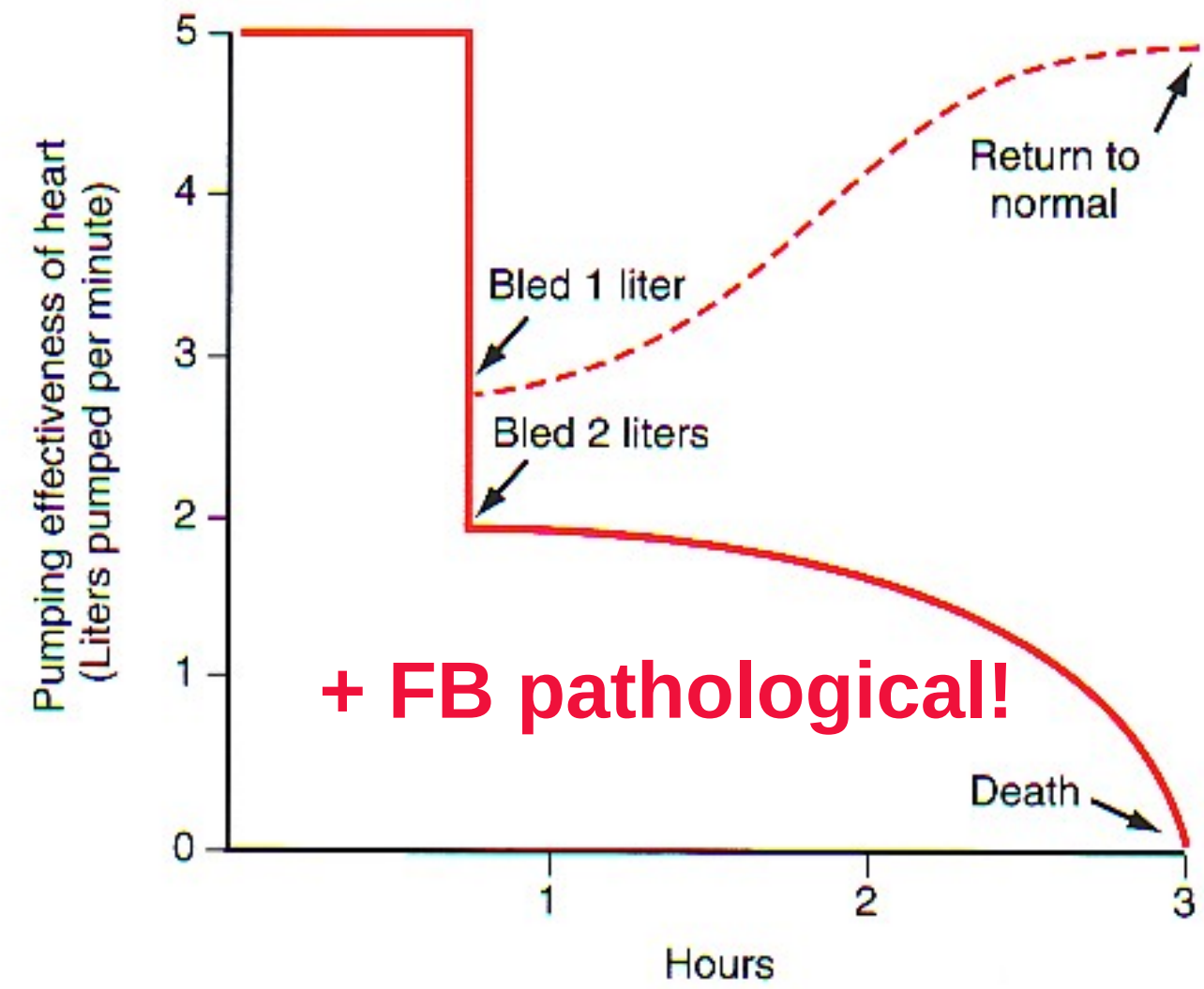
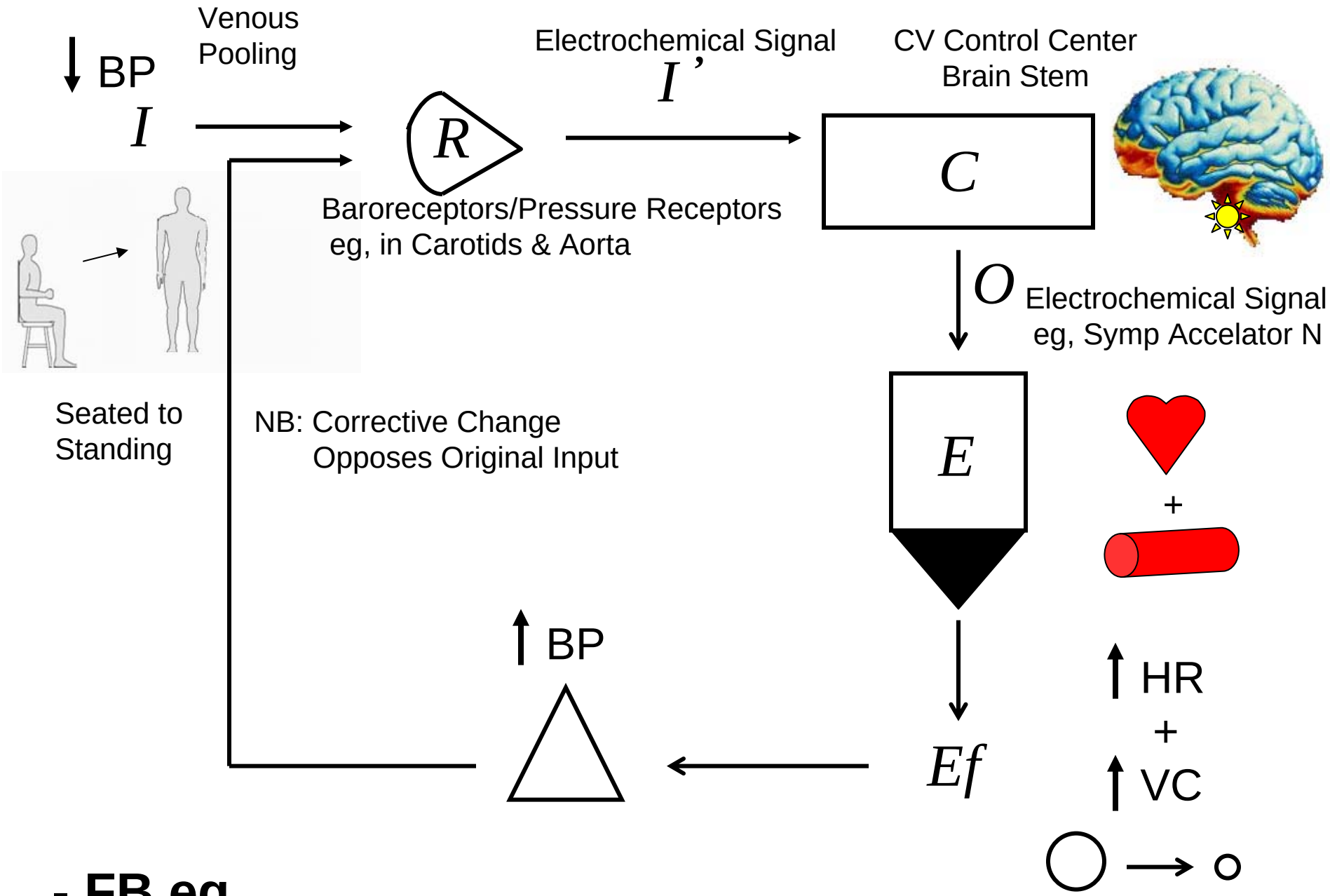


FIGURE 1–3

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.


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

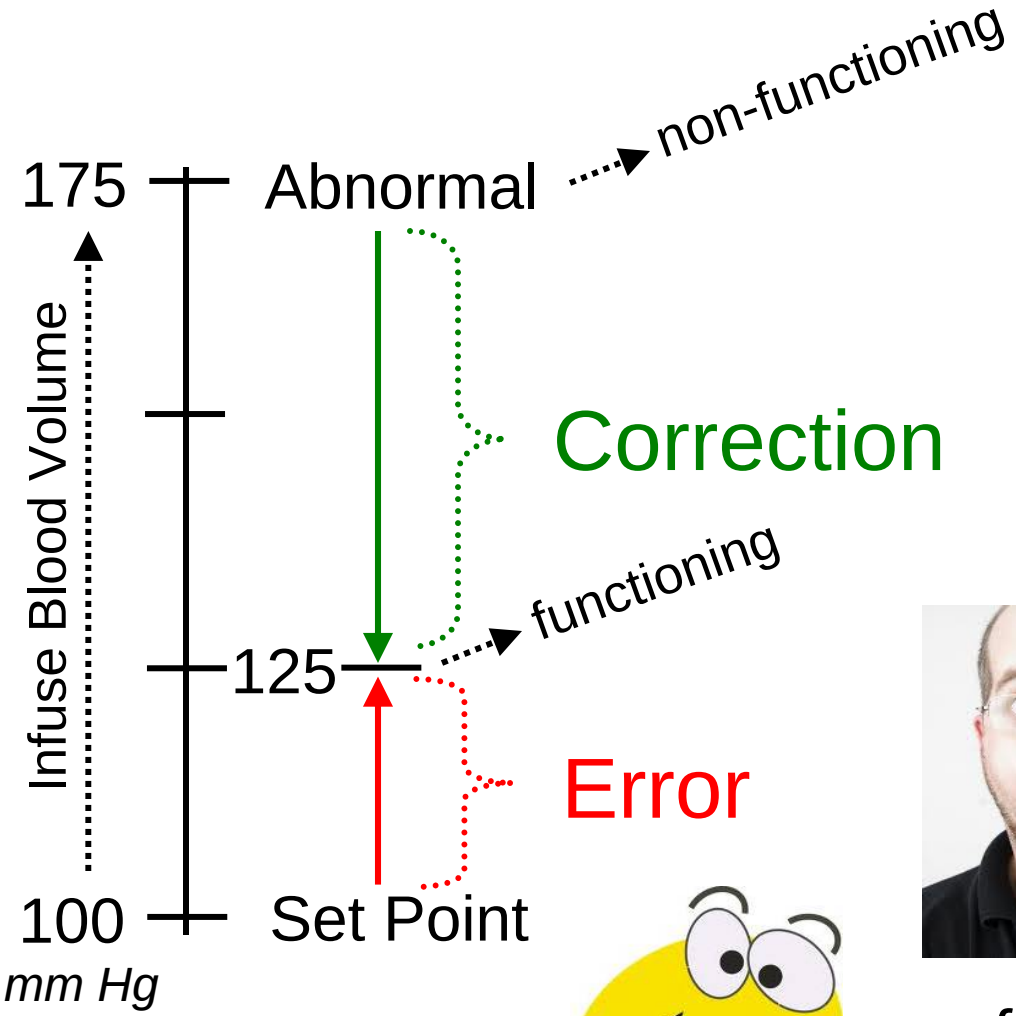
BP: 100 mm Hg → 175 mm Hg

...into person with functioning system

BP: 100 mm Hg → 125 mm Hg

G&H pp 7-8

Gain *for Human Baroreceptor System?*



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

cf: Gain for Human Body Temperature = -33