

REFRAMING SHOCK II:

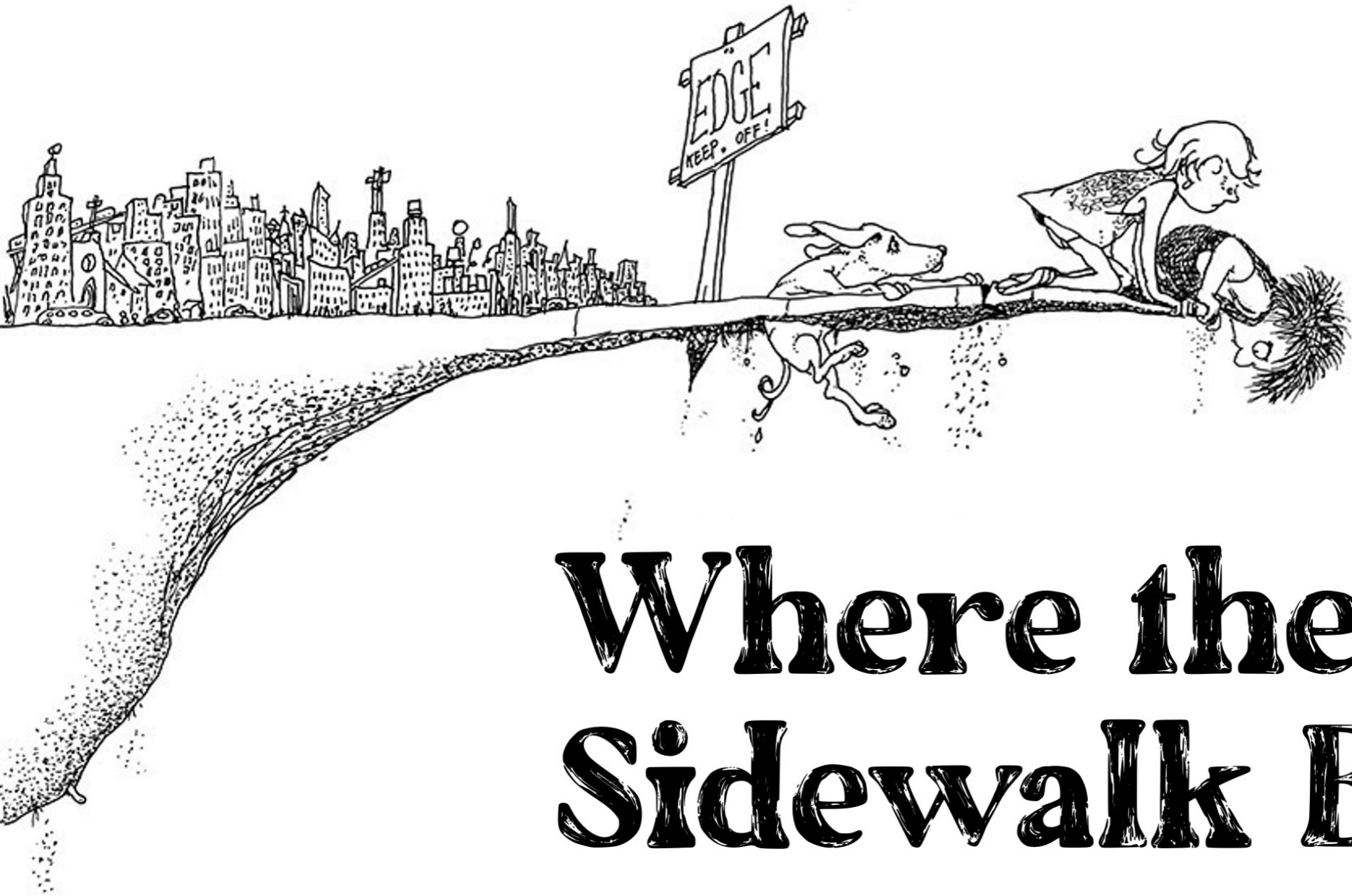
3-PRESSURES SHOCK PHYSIOLOGY





CRITICAL CARE CONSULT

"56M h/o HIV p/w fever and shortness of breath. Hypotensive to 80/40, lactate 3, CXR with multifocal infiltrates. BP not improving after 2L of IV fluid even though good biventricular function on bedside echo. Patient now maxed on norepi and repeat lactate 6."



Where the Sidewalk Ends

How should we go
about improving our
approach to difficult
clinical problems?



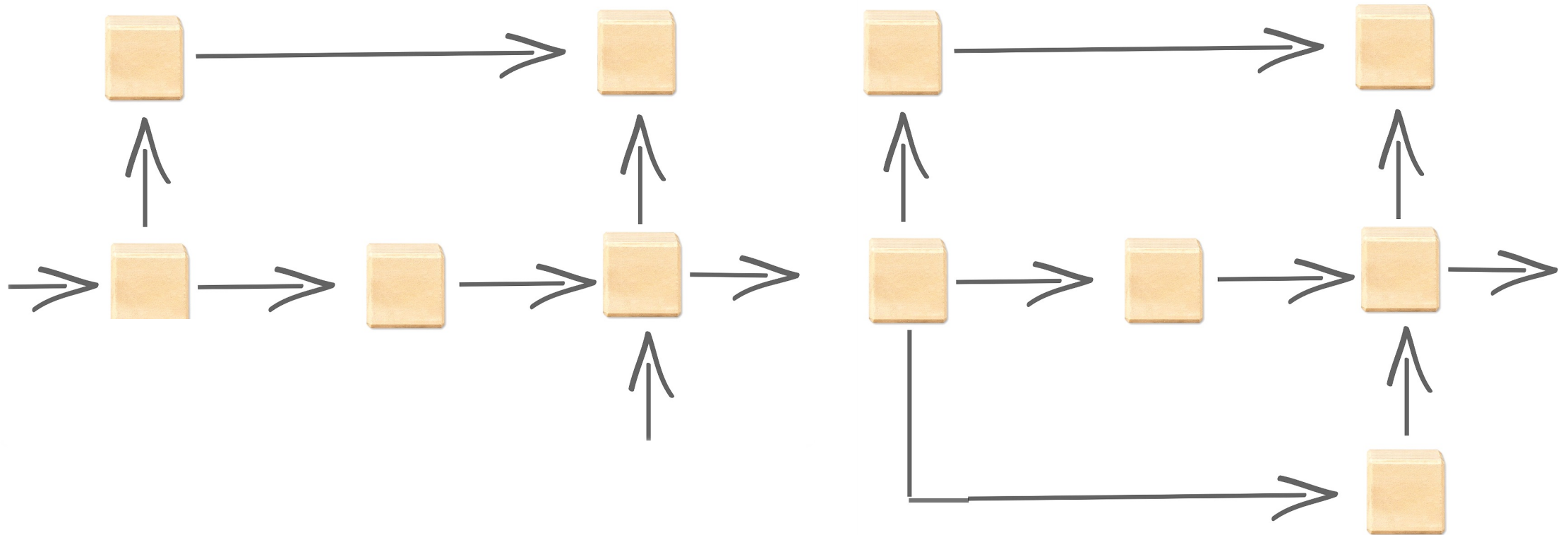


FANCIER
TECHNOLOGY?

**MORE
RESEARCH?**



NEW ALGORITHMS?



“

"...the illusory sense of
psychological order provided
by a seemingly precise tool"

~ *Green & Schriger*

Annals of Emergency Medicine 2017;70(2):158-160



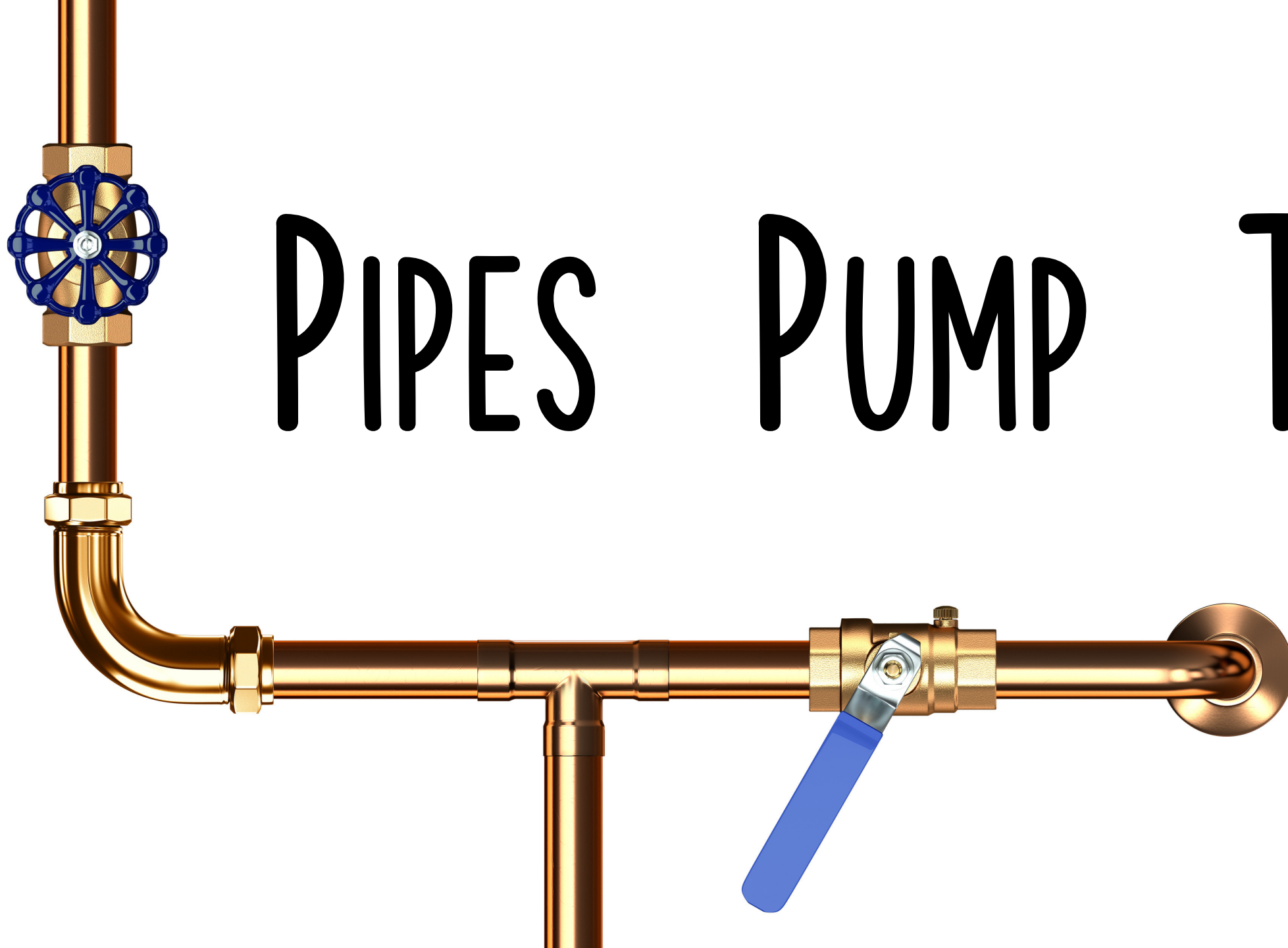
THINK BETTER



**HYPOVOLEMIC
DISTRIBUTIVE
CARDIOGENIC
OBSTRUCTIVE**



Ms. A Cardiogenic	Mr. C Distributive	Ms. H Hypovolemic	Mr. E Cardiogenic	Mr. K Hypovolemic
Ms. J Hypovolemic	Ms. T Obstructive	Mr. J Distributive	Ms. M Distributive	Mr. R Cardiogenic
Ms. S Distributive	Ms. W Cardiogenic	Ms. L Hypovolemic	Ms. O Obstructive	Mr. Q Cardiogenic



PIPES PUMP TANK

Tool for
gathering data



IF THE ONLY WAY YOU HAVE TO ORGANIZE THAT DATA IS TO PUT IT BACK IN THE SAME OLD BOXES...

Ms. A Cardiogenic	Mr. C Distributive	Ms. H Hypovolemic	Mr. E Cardiogenic	Mr. K Hypovolemic
Ms. J Hypovolemic	Ms. T Obstructive	Mr. J Distributive	Ms. M Distributive	Mr. R Cardiogenic
Ms. S Distributive	Ms. W Cardiogenic	Ms. L Hypovolemic	Ms. O Obstructive	Mr. Q Cardiogenic

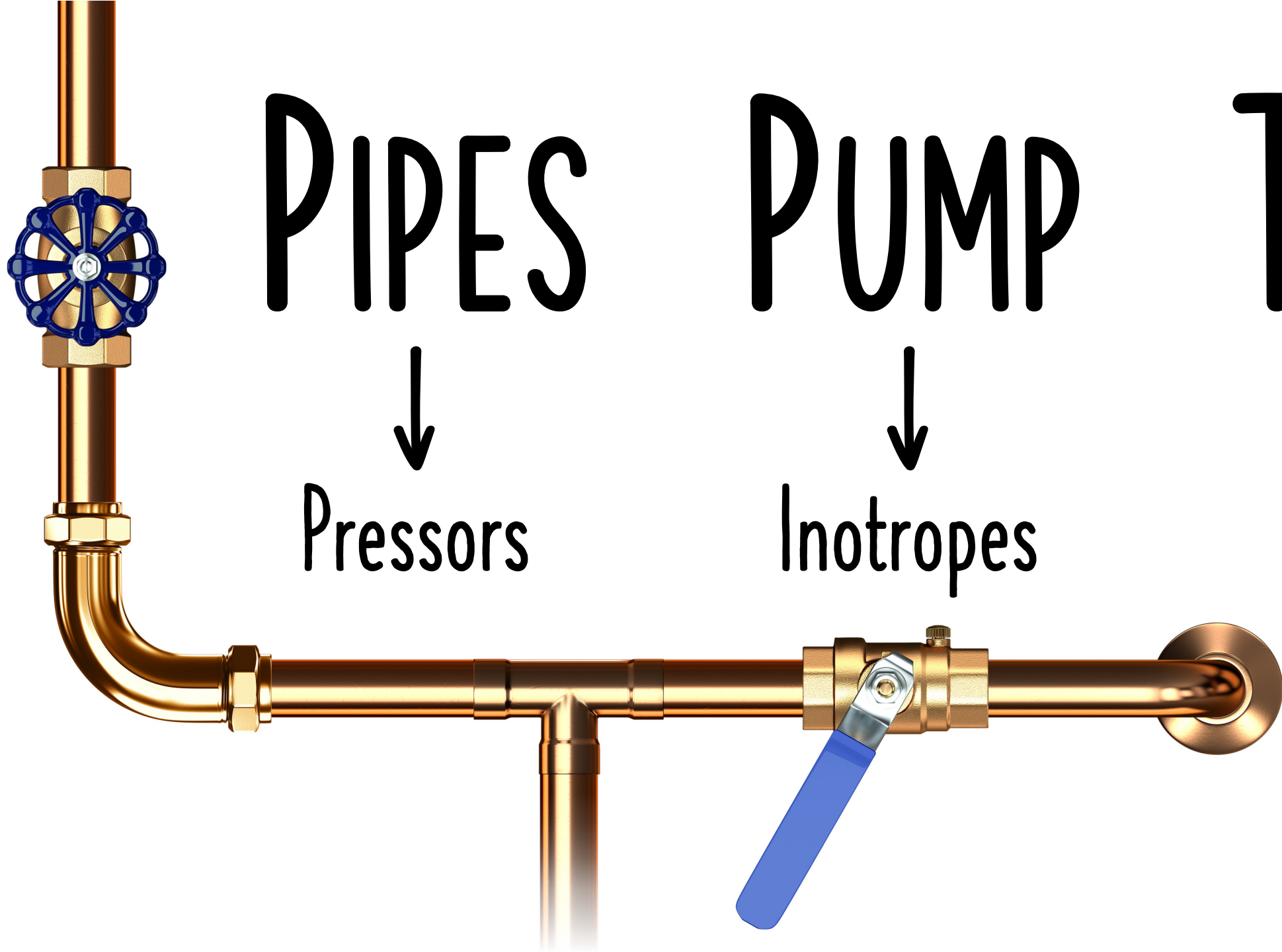


HYPOVOLEMIC → Volume

DISTRIBUTIVE → Pressors

CARDIOGENIC → Inotropes

OBSTRUCTIVE → Decompression



PIPES



Pressors

PUMP

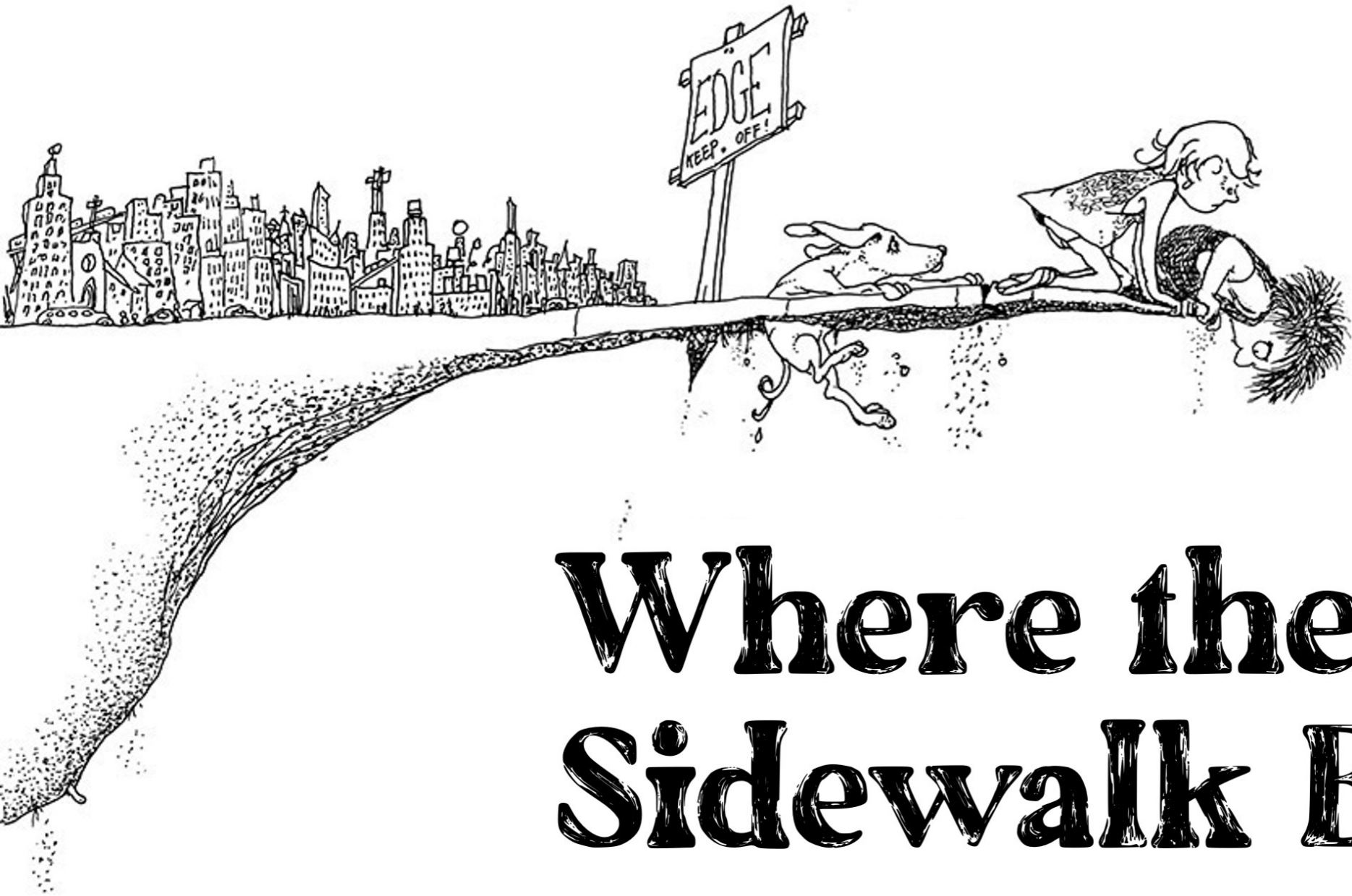


Inotropes

TANK



Volume

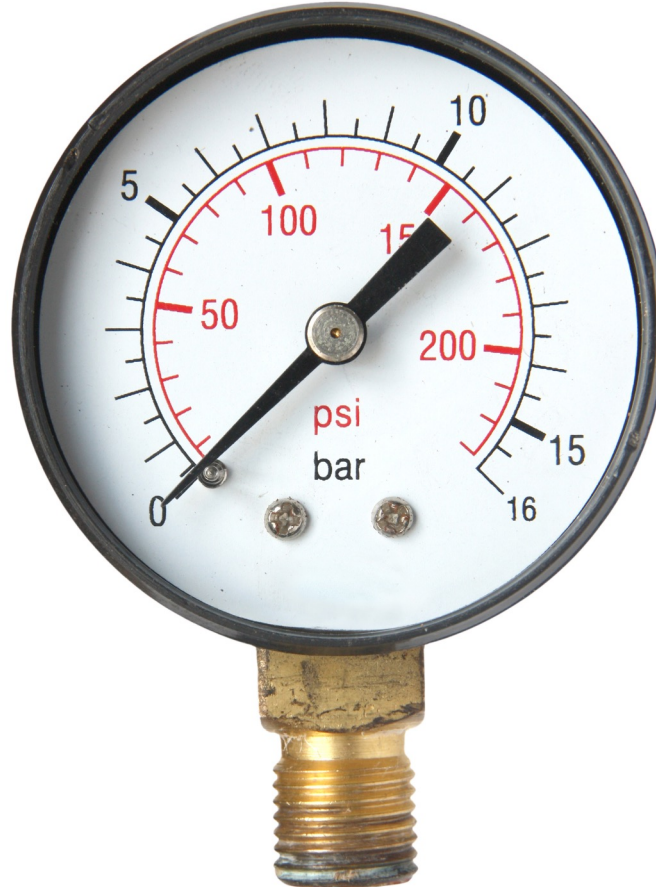


Where the Sidewalk Ends



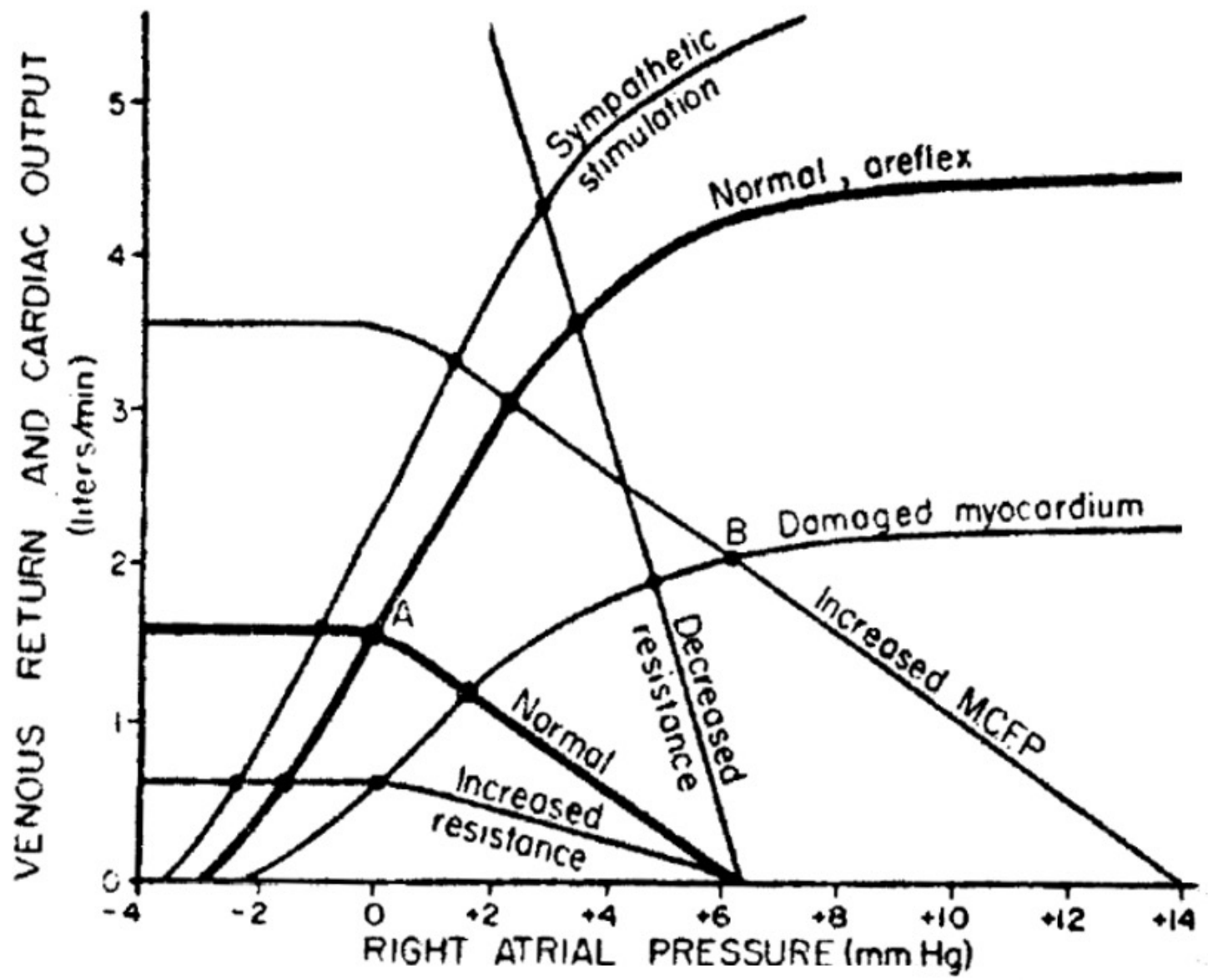
REFRAMING OUR MENTAL MODEL OF SHOCK PHYSIOLOGY

PERFUSION PRESSURE





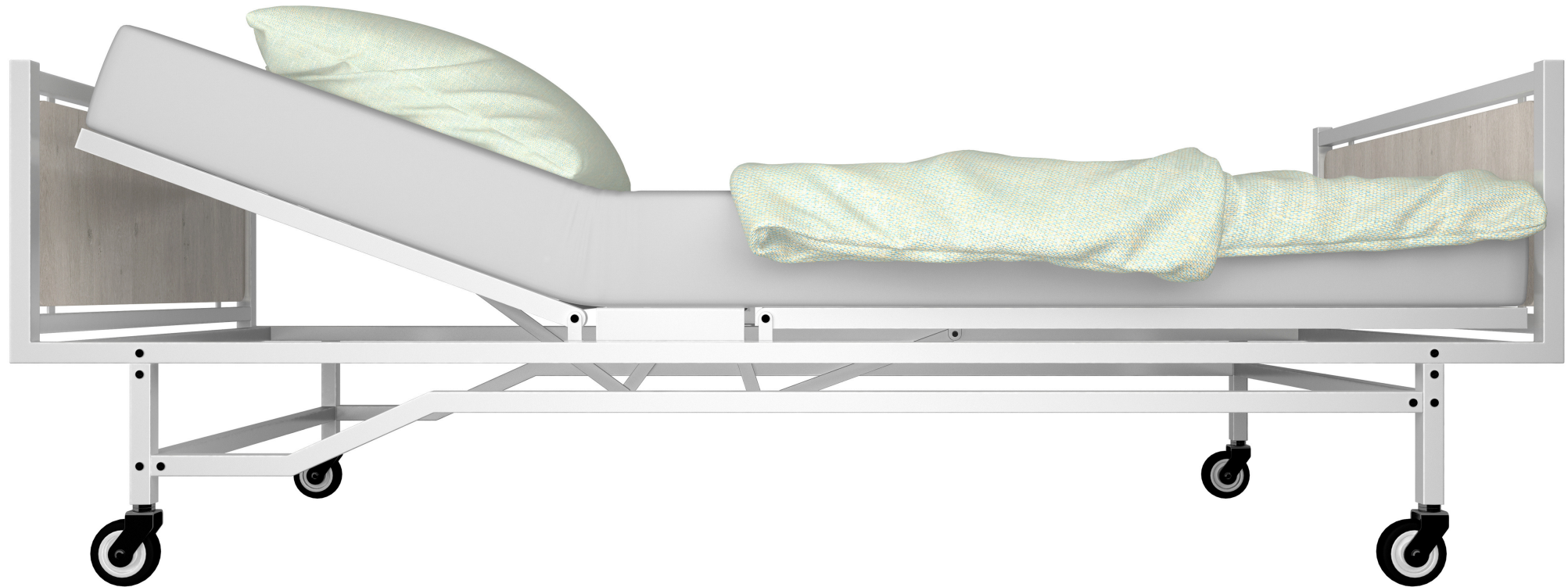
**NON-NOVEL
CONCEPT**



... but it hasn't quite caught on yet for a reason



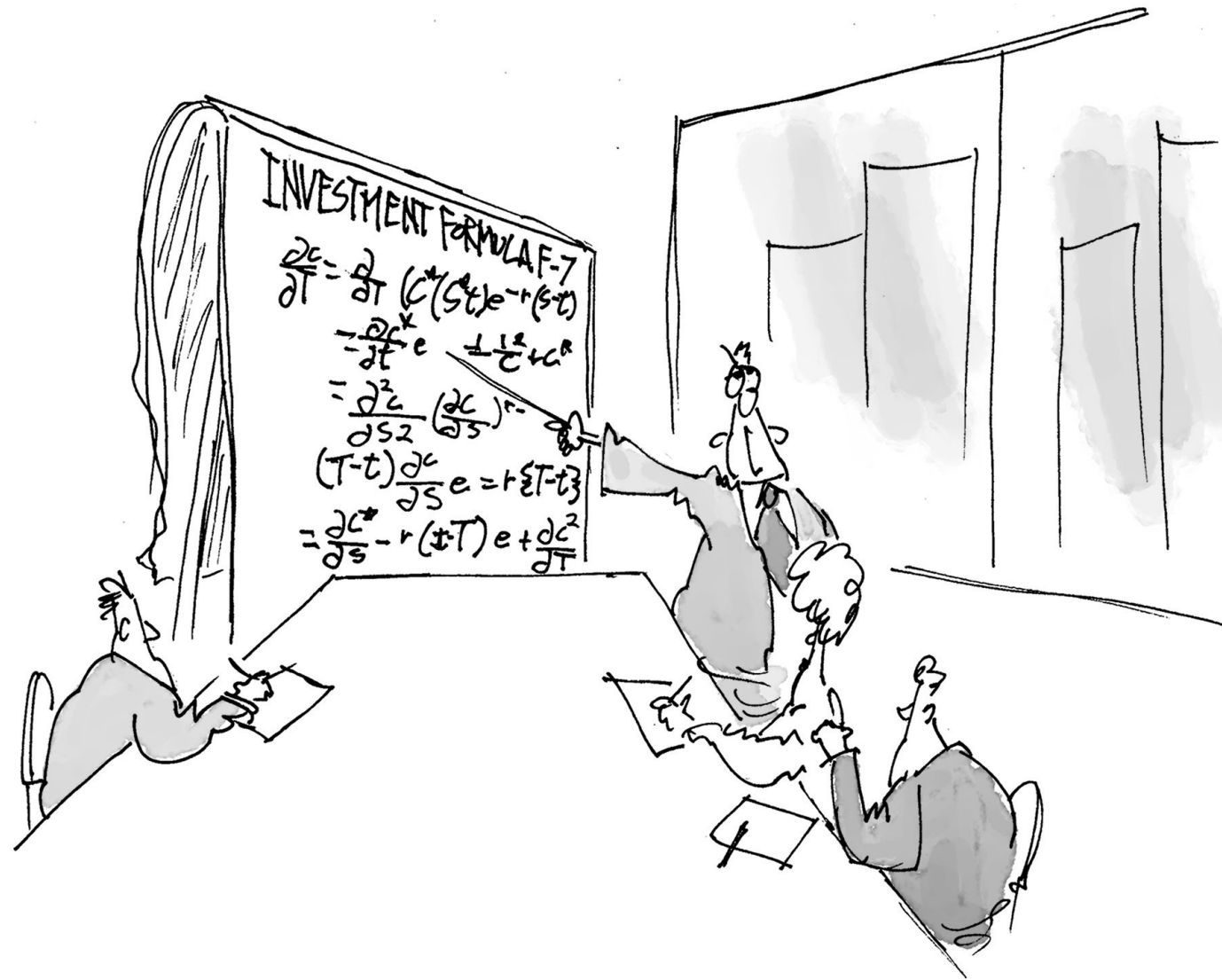
FUNCTIONAL AT BEDSIDE





HEURISTIC PHYSIOLOGY

ADVANCED
SIMPLIFICATION



Well yes, Simson. I suppose another way of putting it is "buy low, sell high"

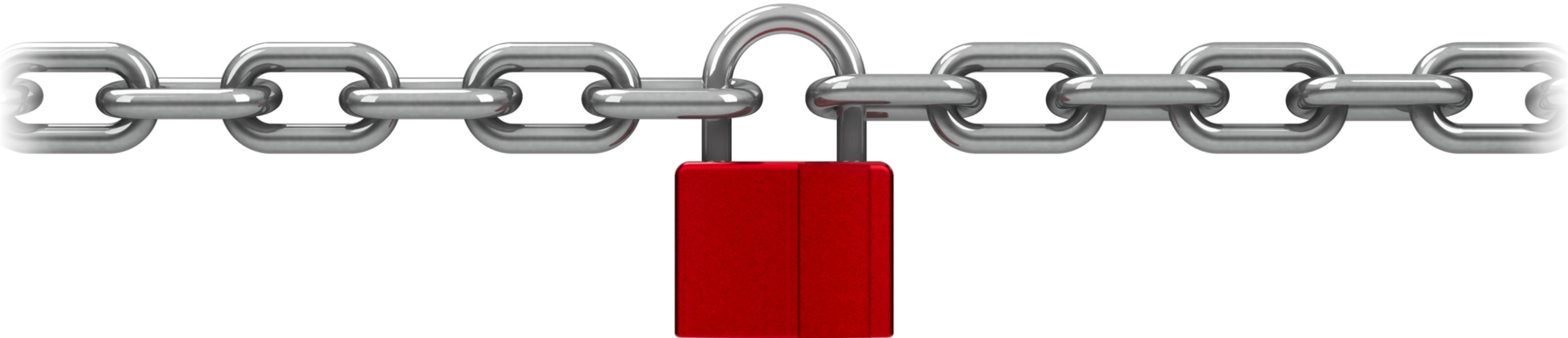


SHOCK \neq
HYPOTENSION

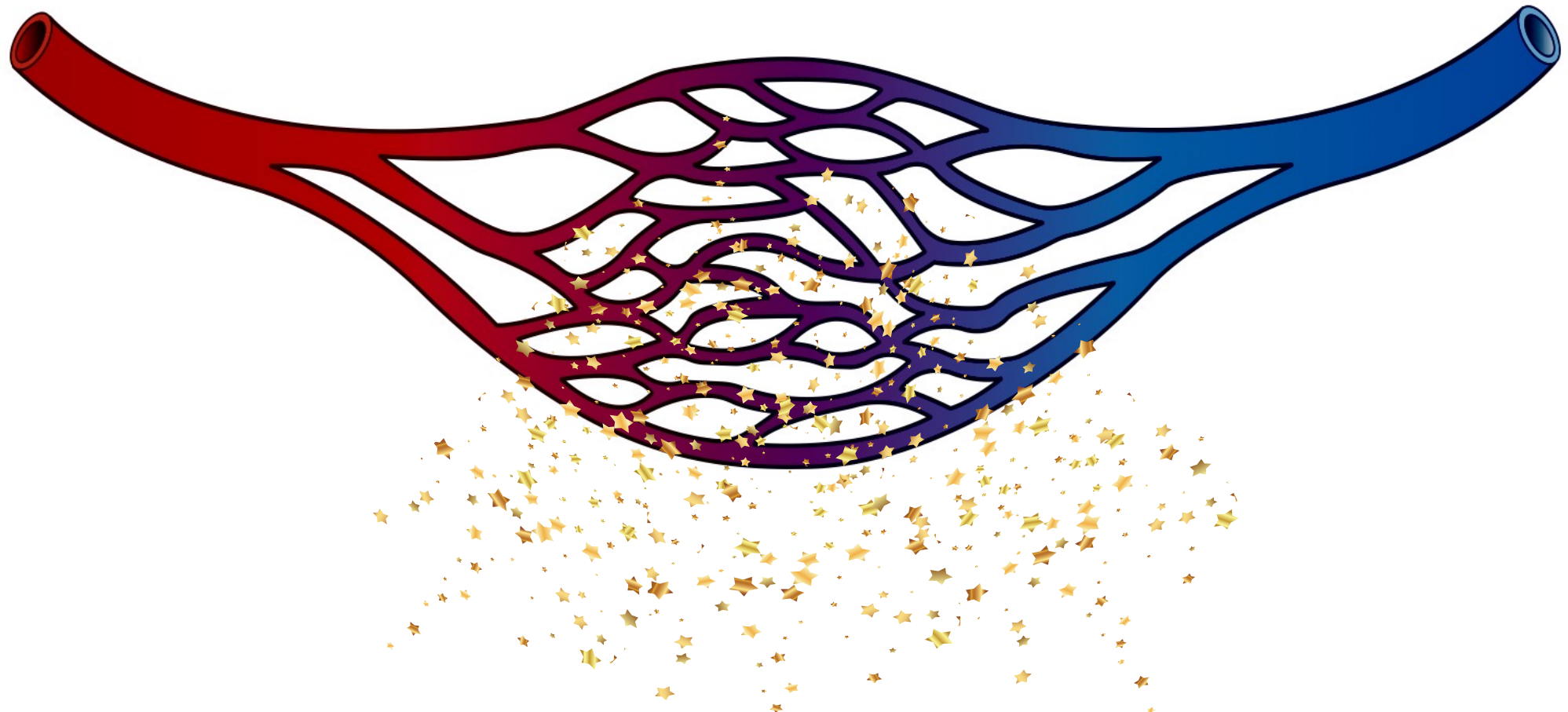
SHOCK =
HYPOPERFUSION

**BLOOD
PRESSURE**

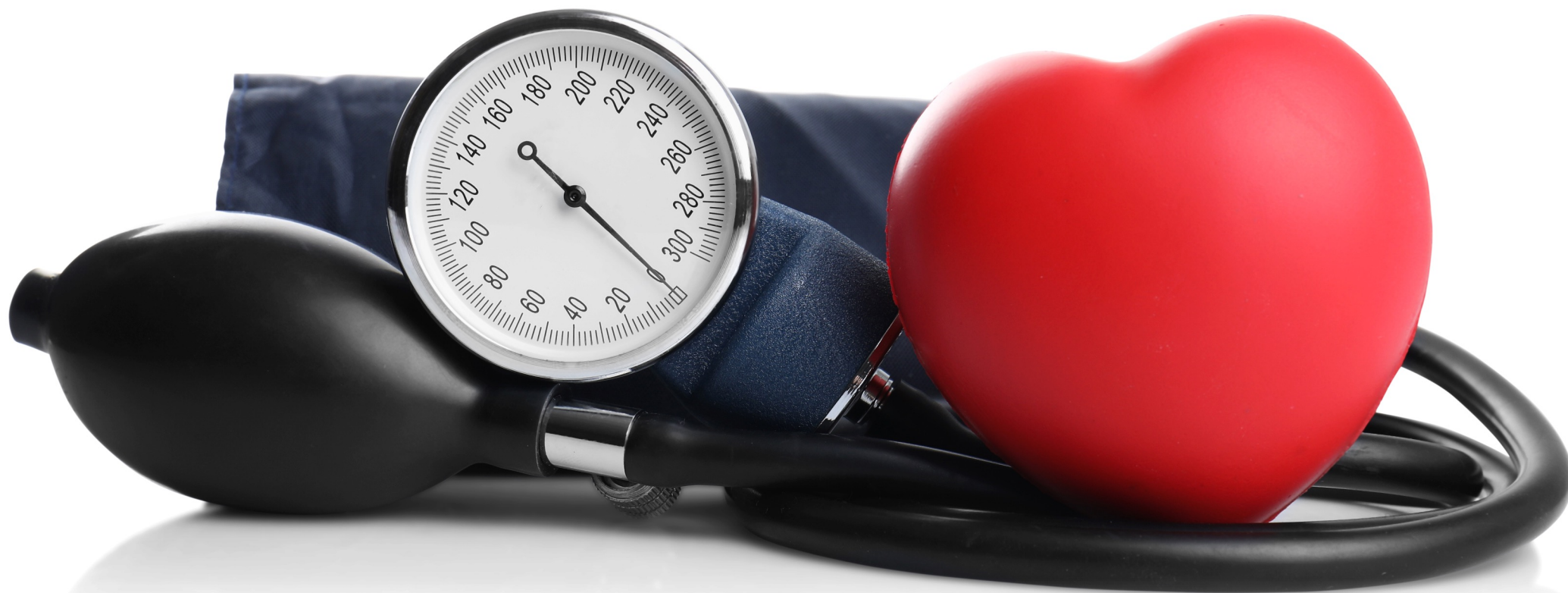
**TISSUE
PERFUSION**



TISSUE PERFUSION



???

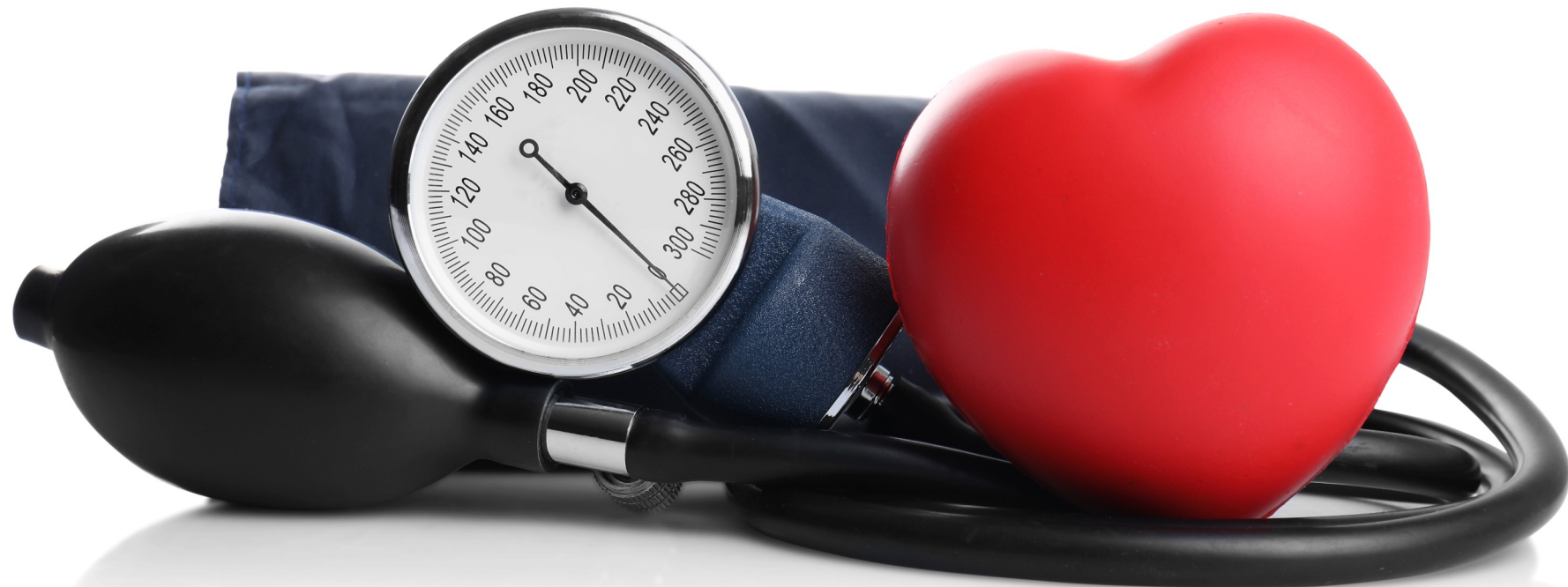


“

"Measure what is important,
don't make important what
you can measure"

~Robert McNamara

OUR BLOOD PRESSURE OBSESSION RUNS DEEP





FORWARD!

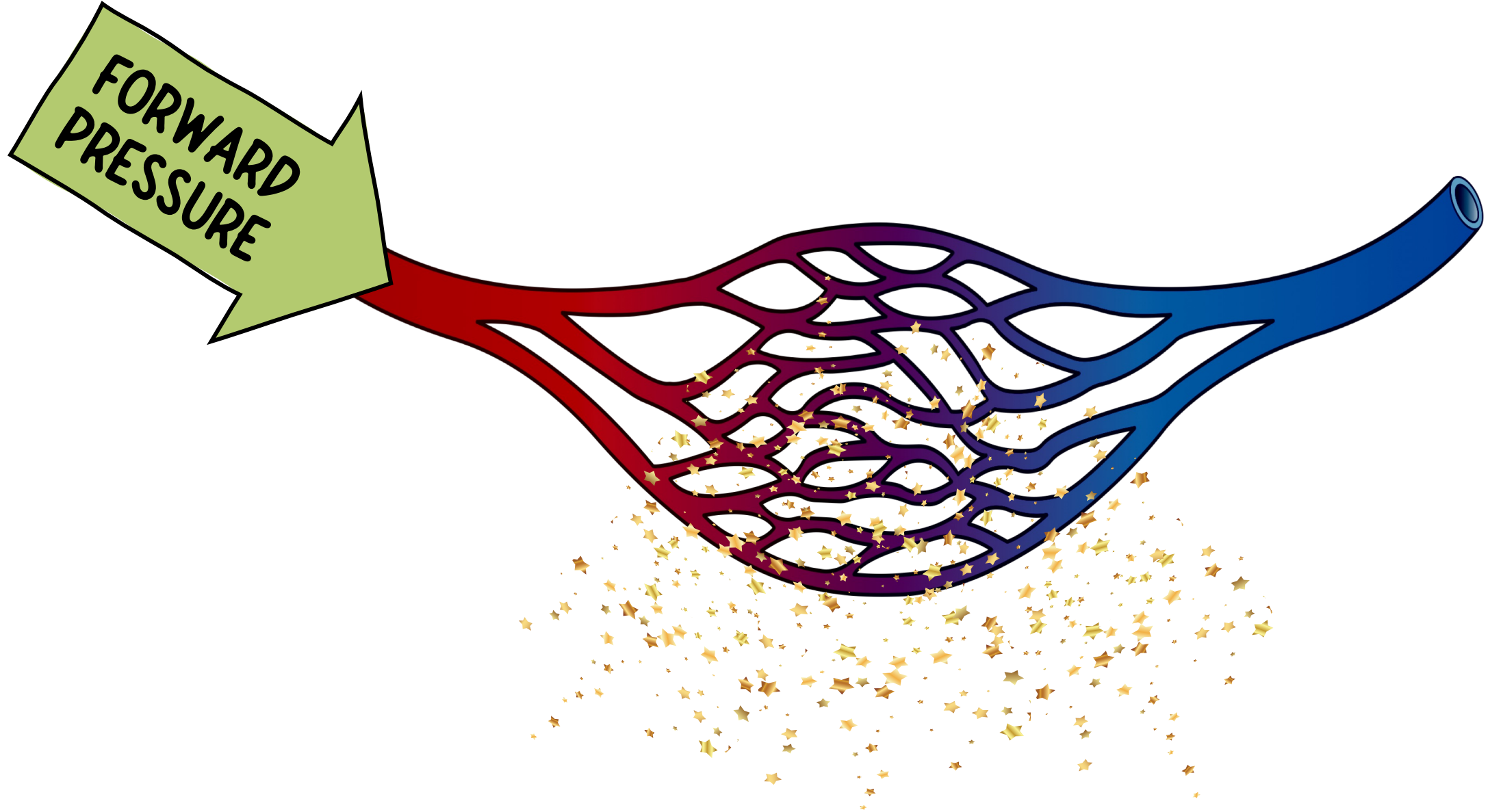


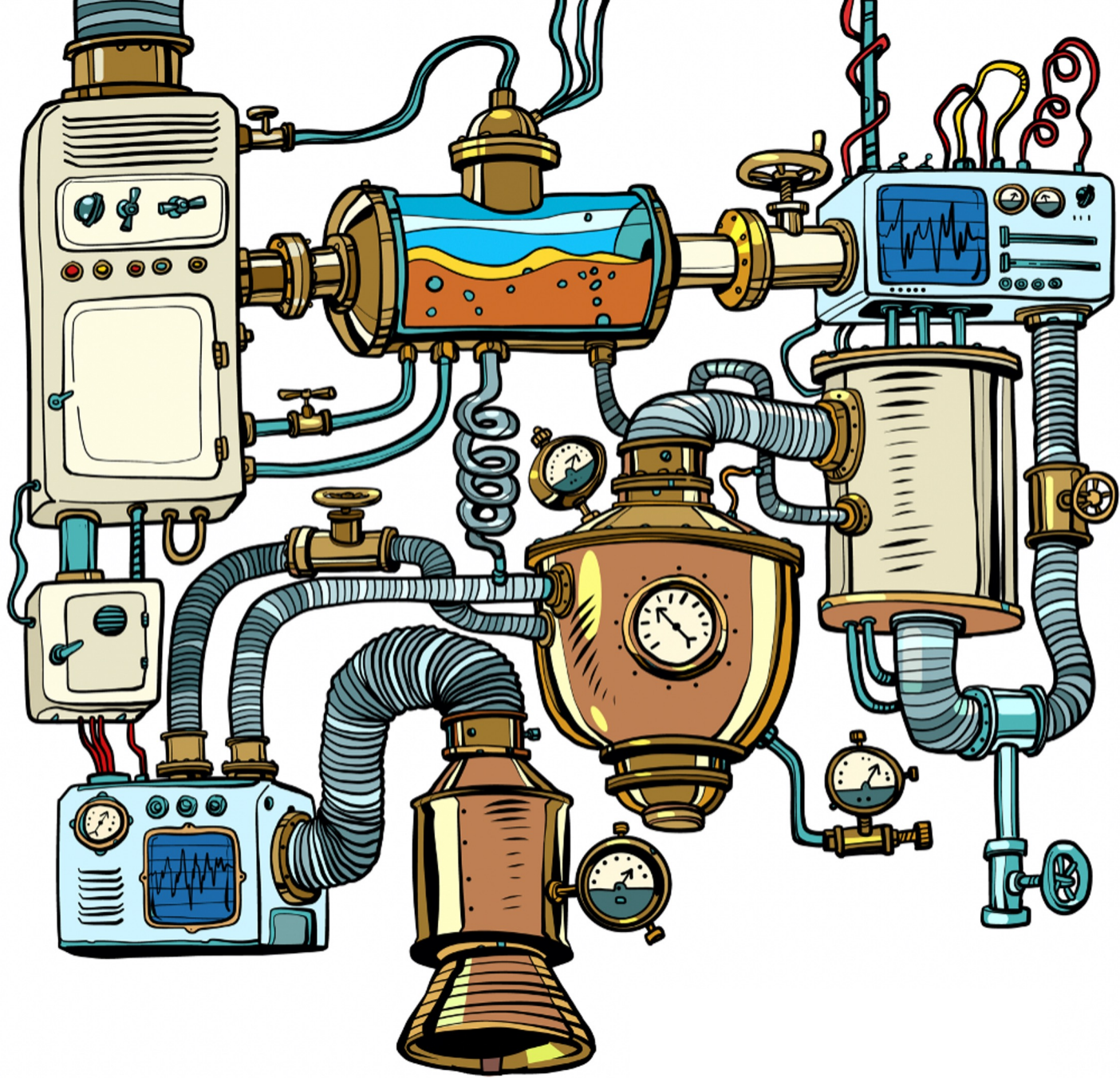
"The nearest exit may be behind you"

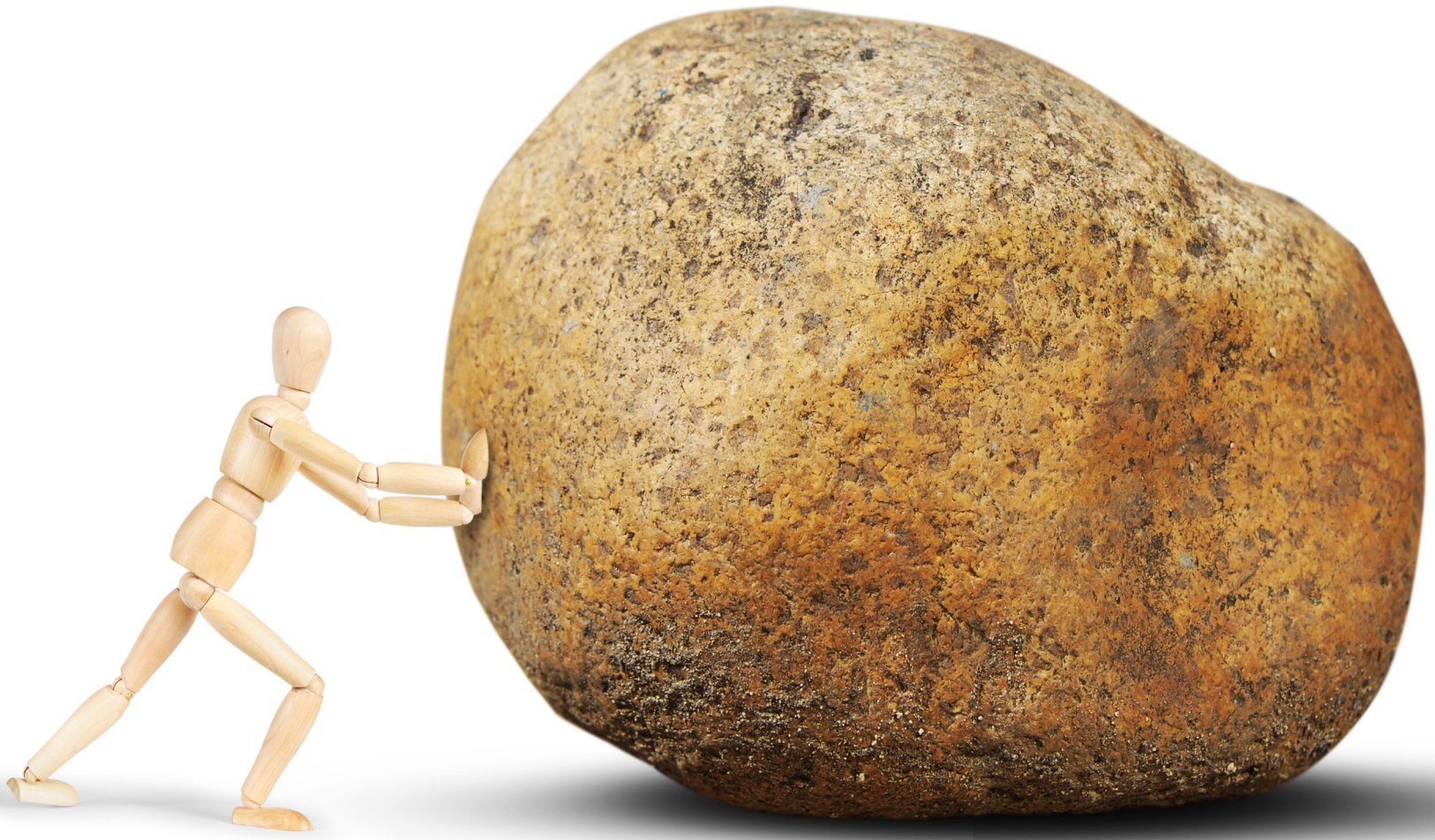
MAP-centric

LVEF-centric







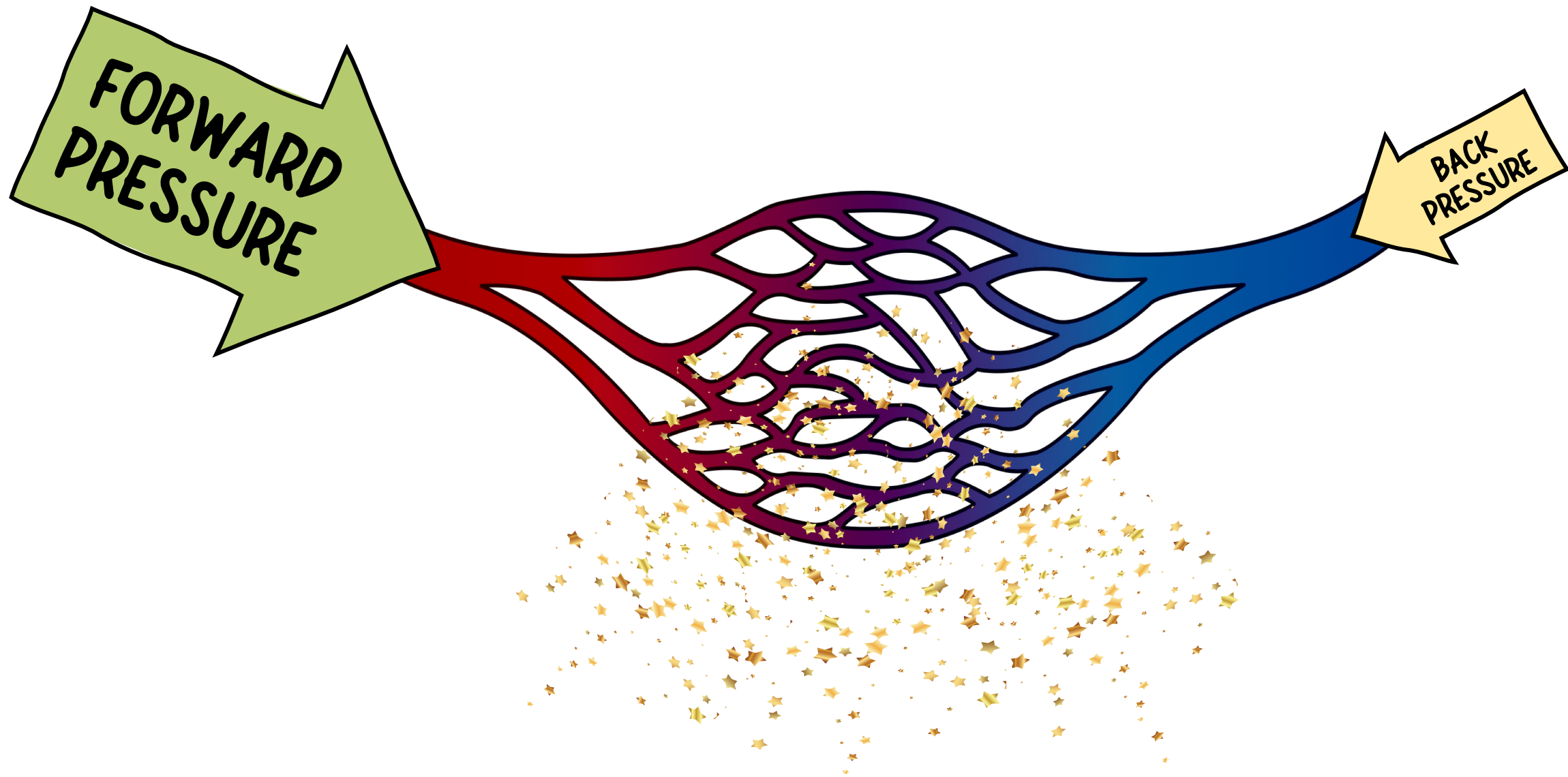


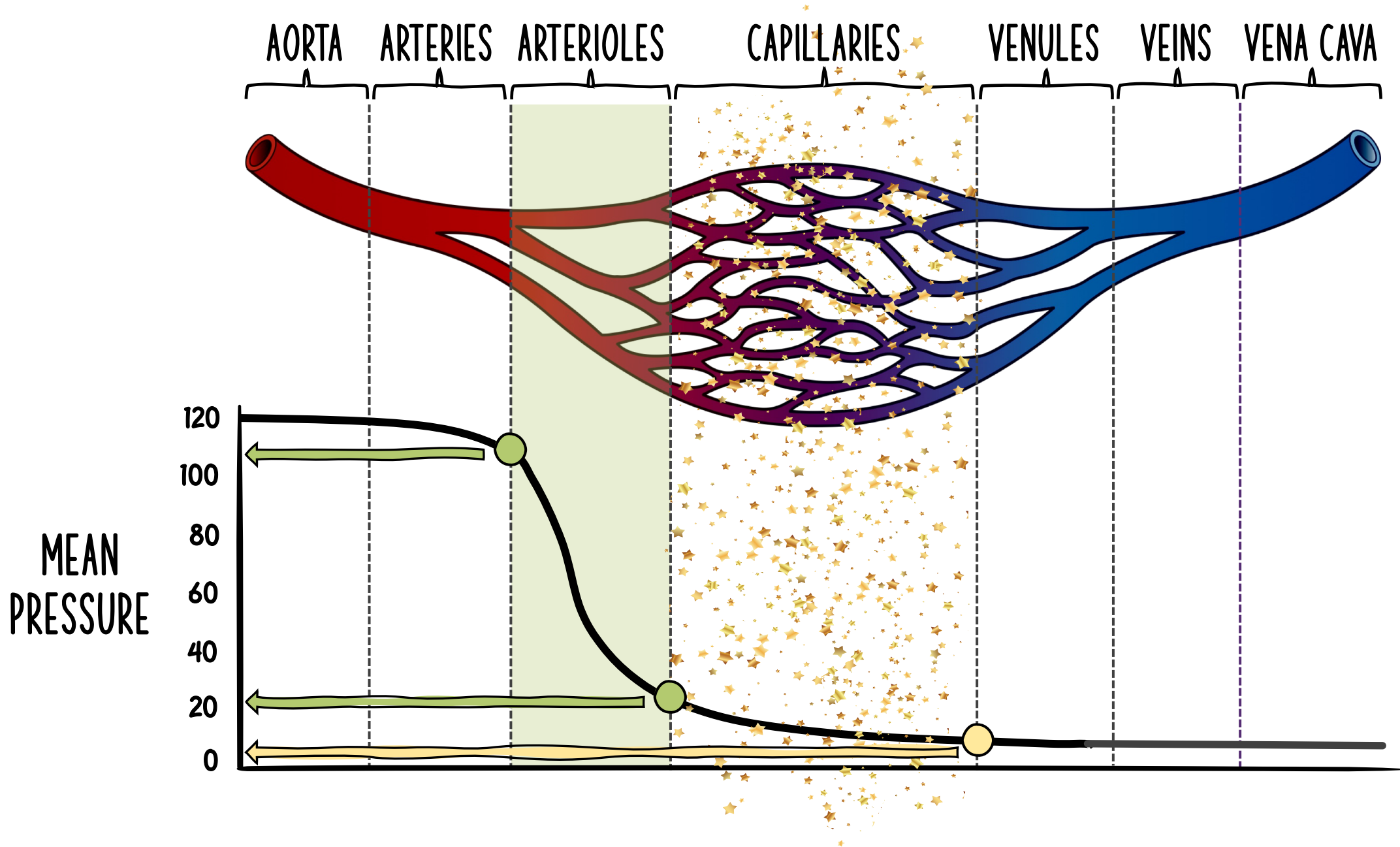


PERFUSION PRESSURE

Forward Pressure - Back Pressure







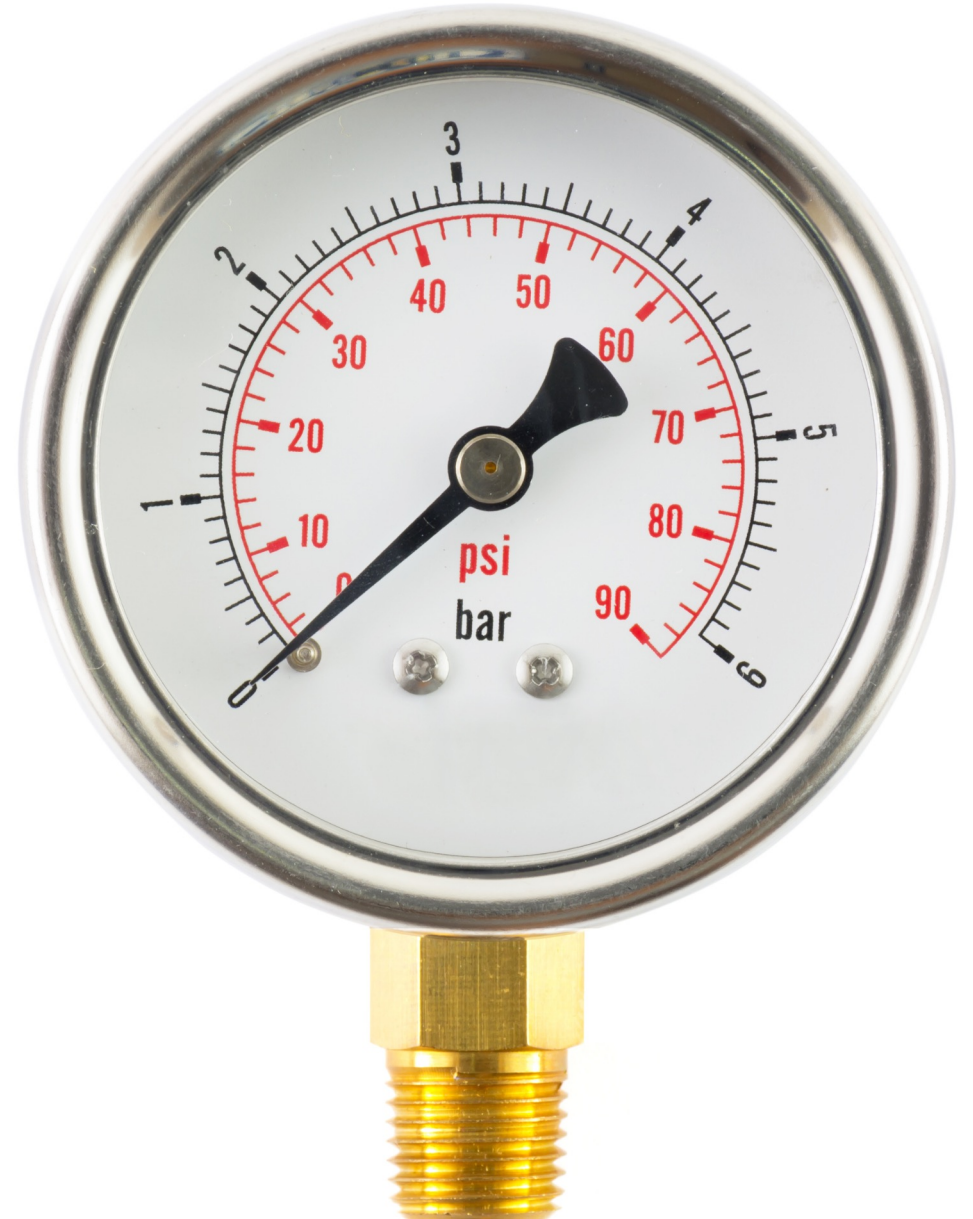


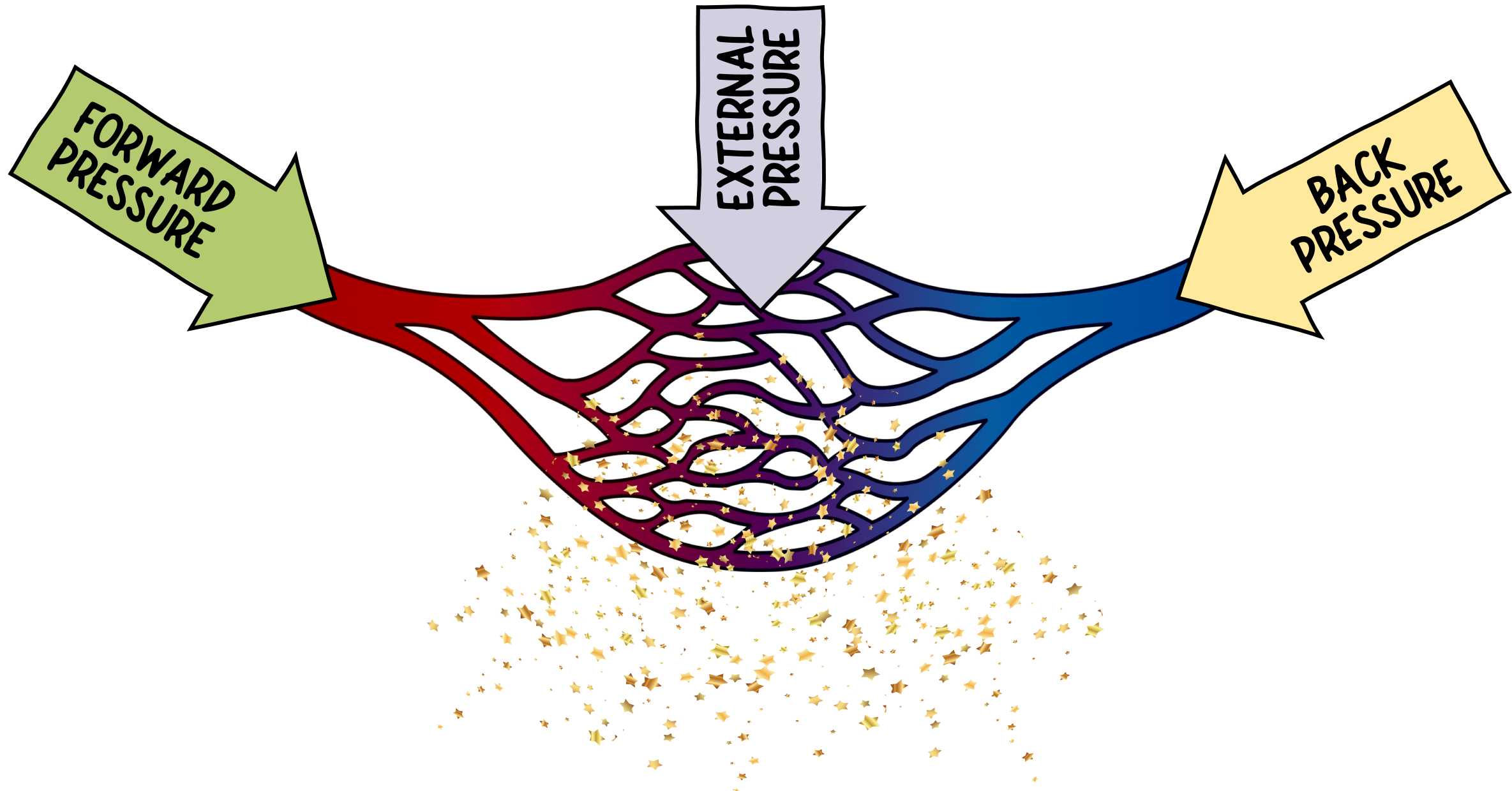
BACKWARD!



INSUFFICIENT FORWARD
PRESSURE...

...OR EXCESSIVE
COMPETING PRESSURES?









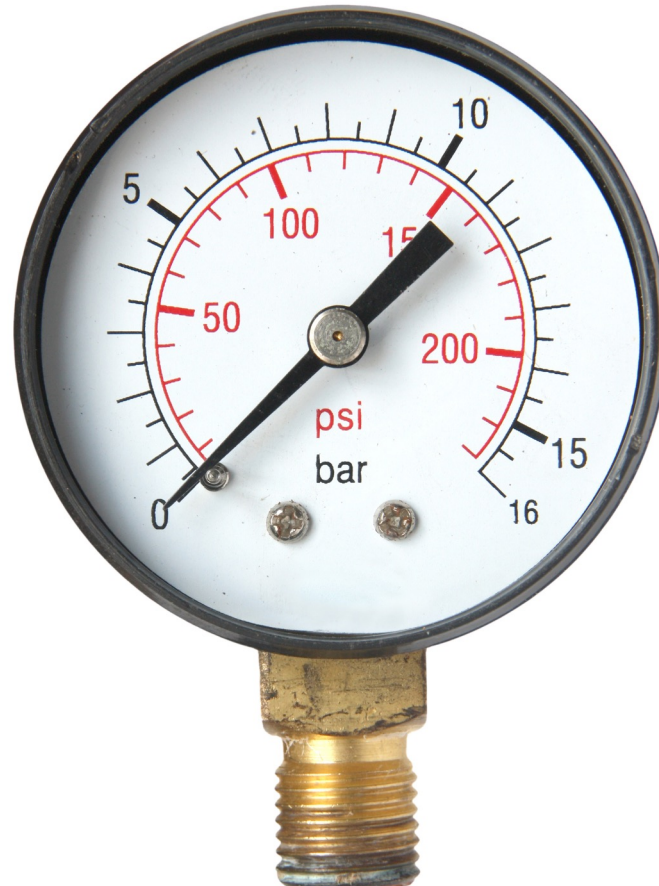
CARDIAC TAMPONADE

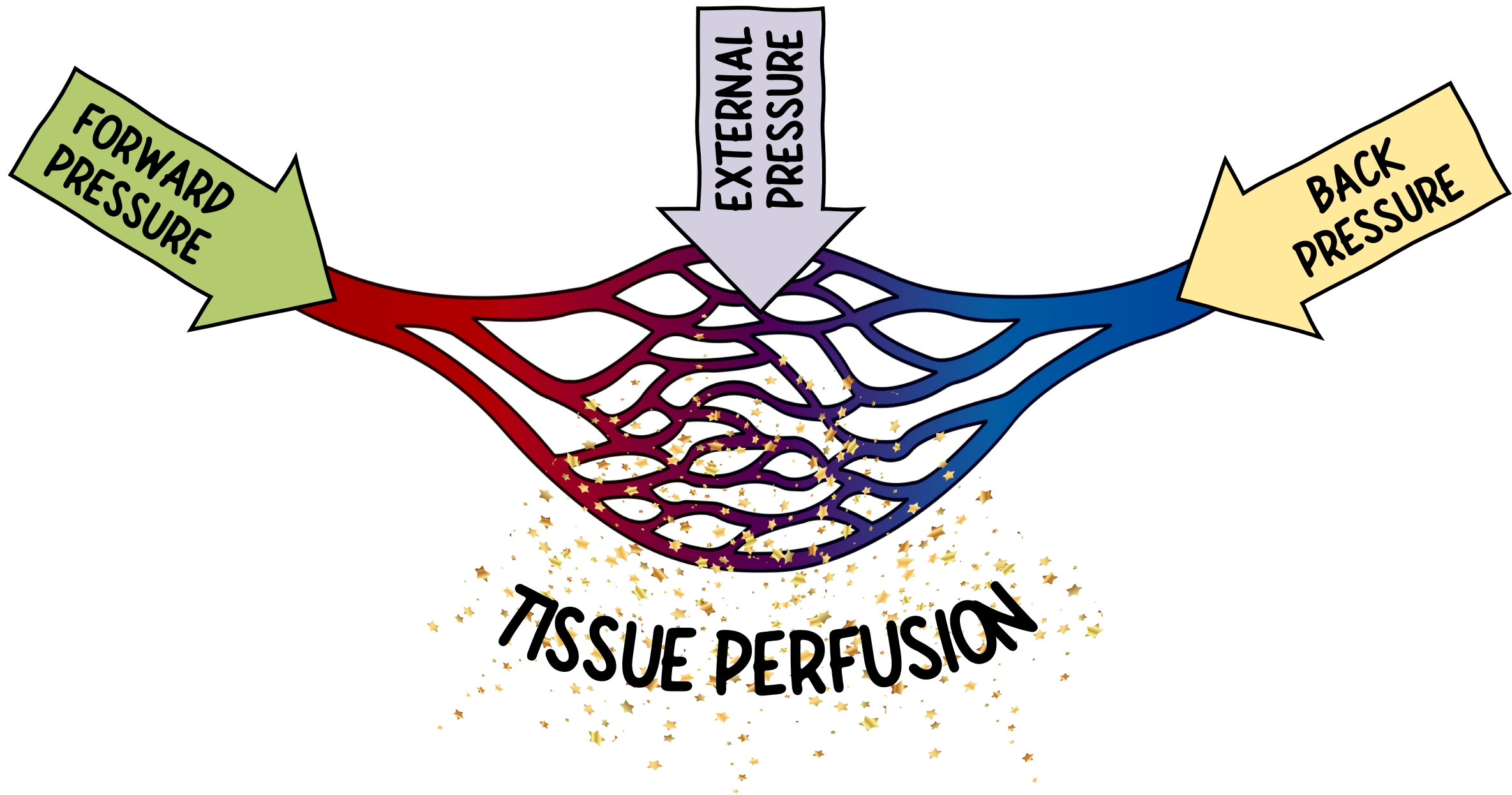
TENSION PNEUMOTHORAX

TISSUE HYDROSTATIC PRESSURE



3-PRESSURES PHYSIOLOGY MAP





FORWARD
PRESSURE

EXTERNAL
PRESSURE

BACK
PRESSURE

TISSUE PERFUSION

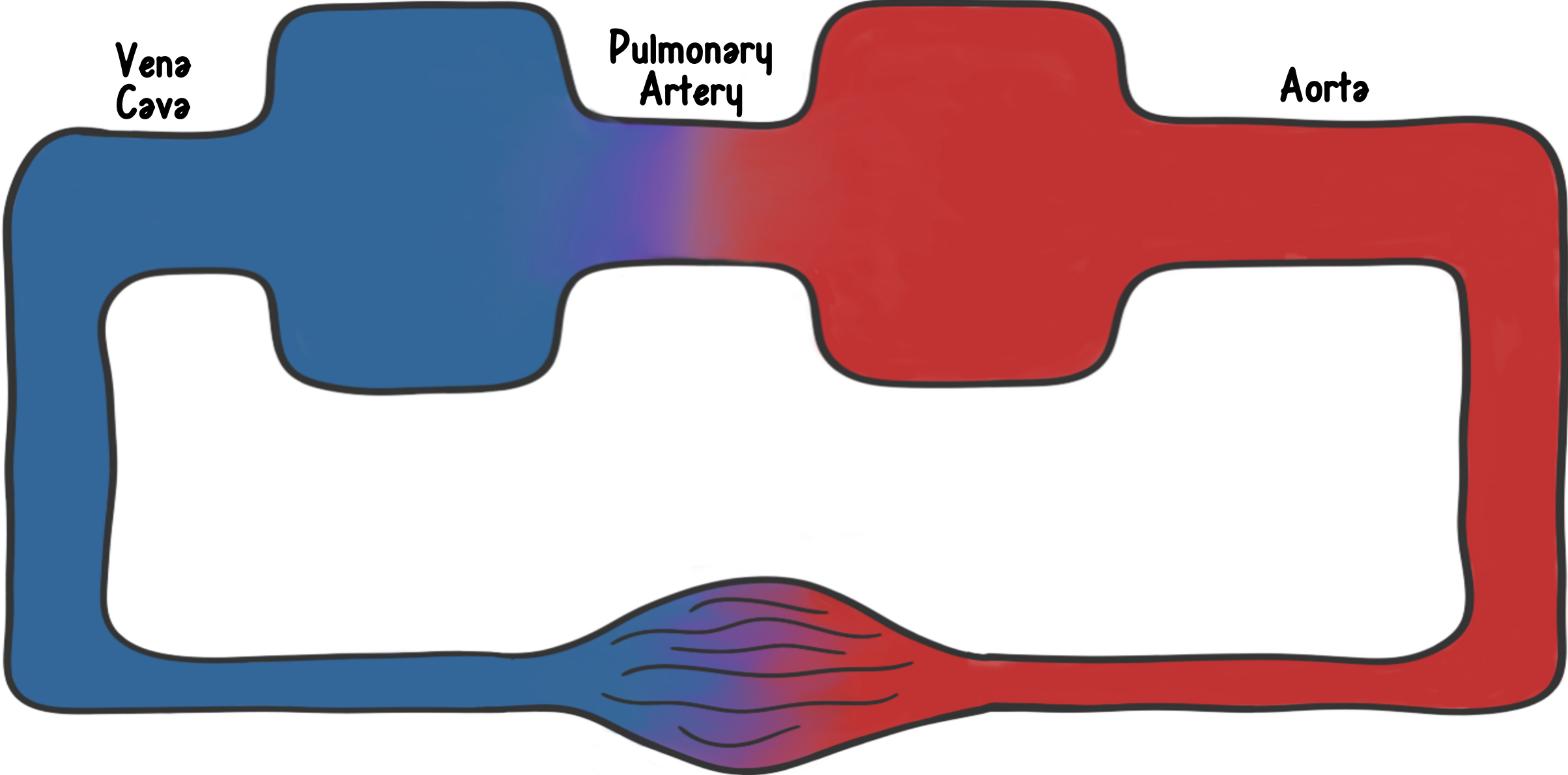
Right Heart

Left Heart

Vena
Cava

Pulmonary
Artery

Aorta



Capillaries



Get a PhD in physiology



Construct a mental model that helps you understand what is happening with your patient

PERFUSION PRESSURE

Forward Pressure - Back Pressure



MEAN PERFUSION PRESSURE

=

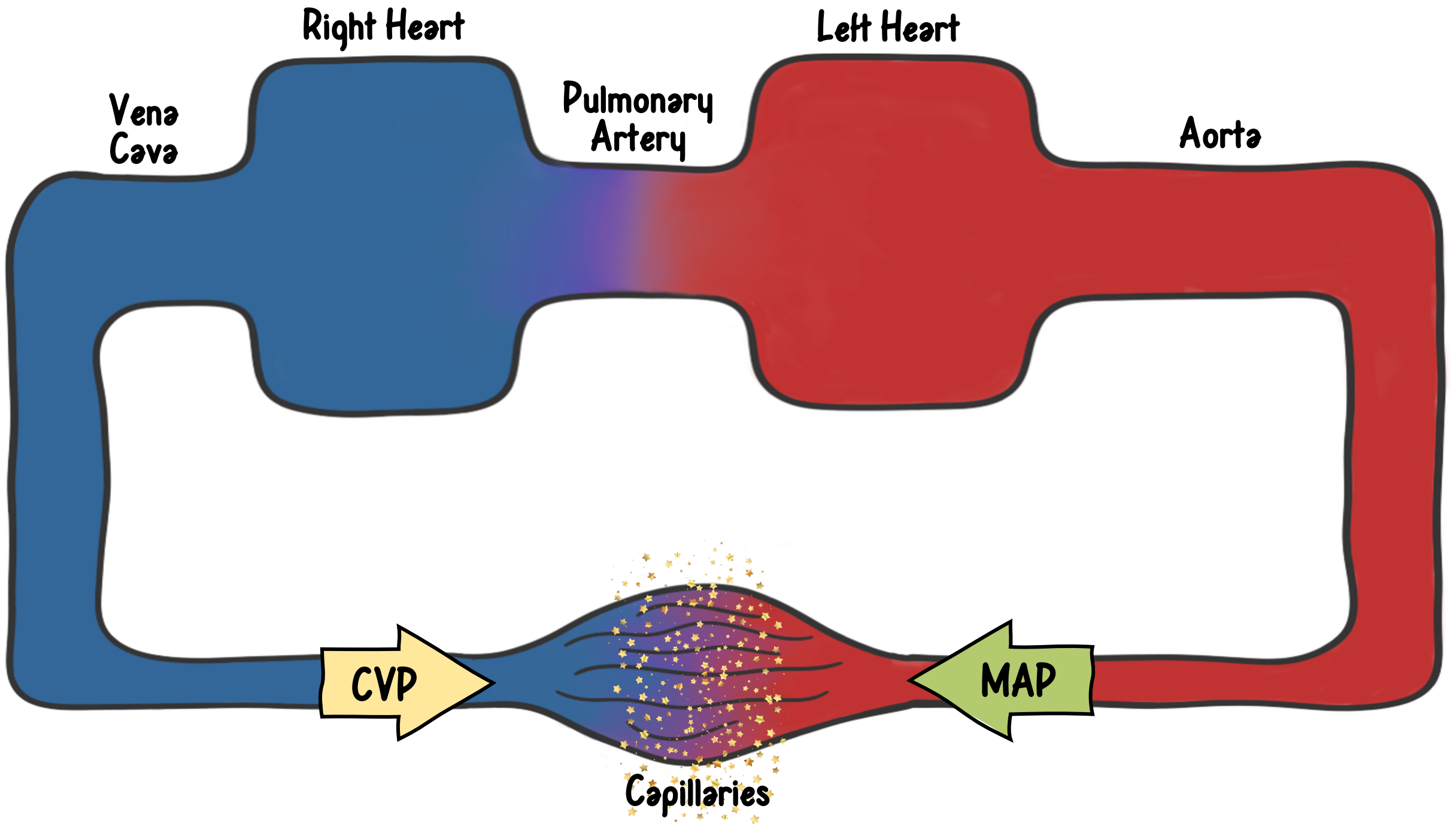
MAP - CVP

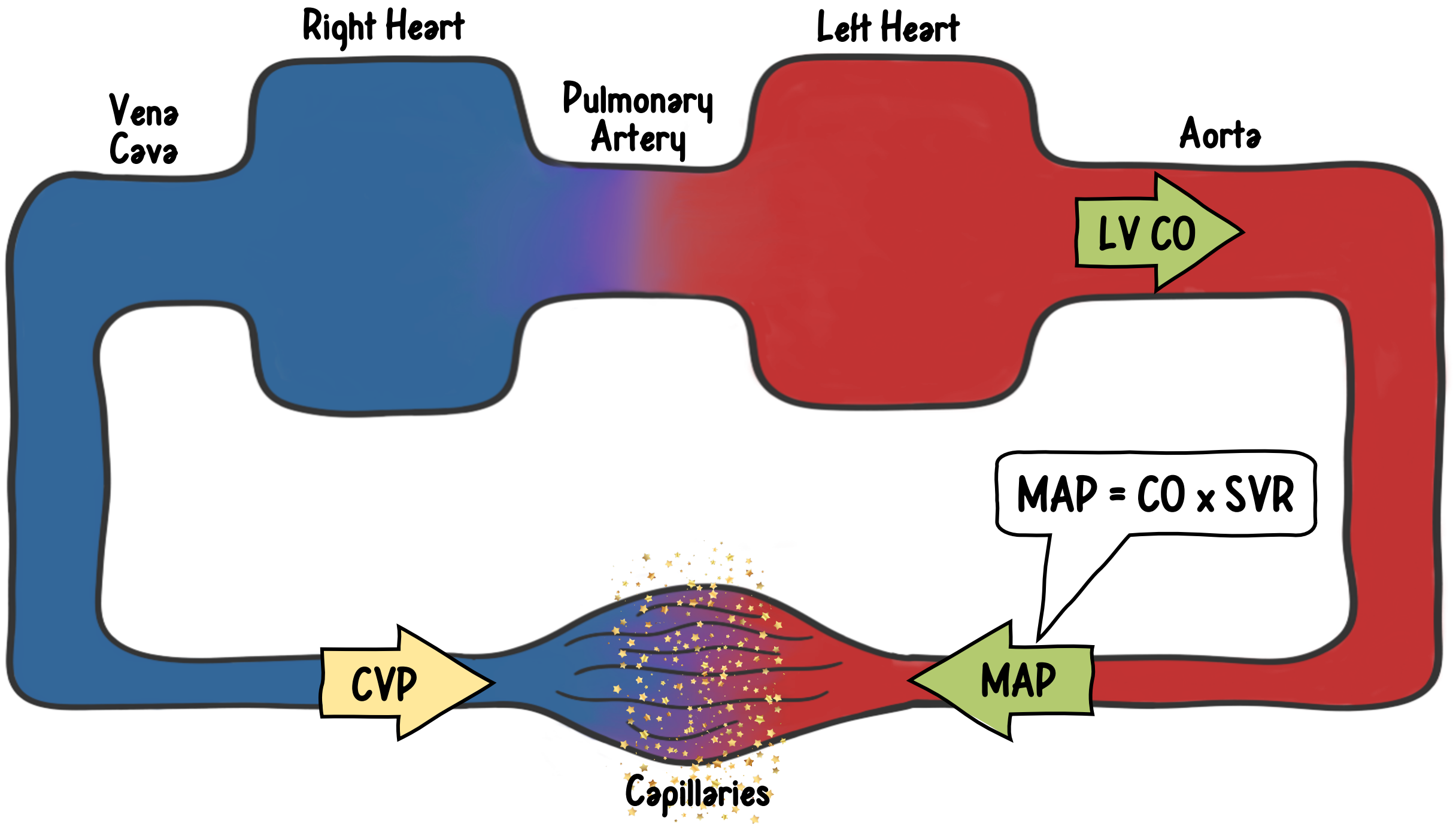


MAP

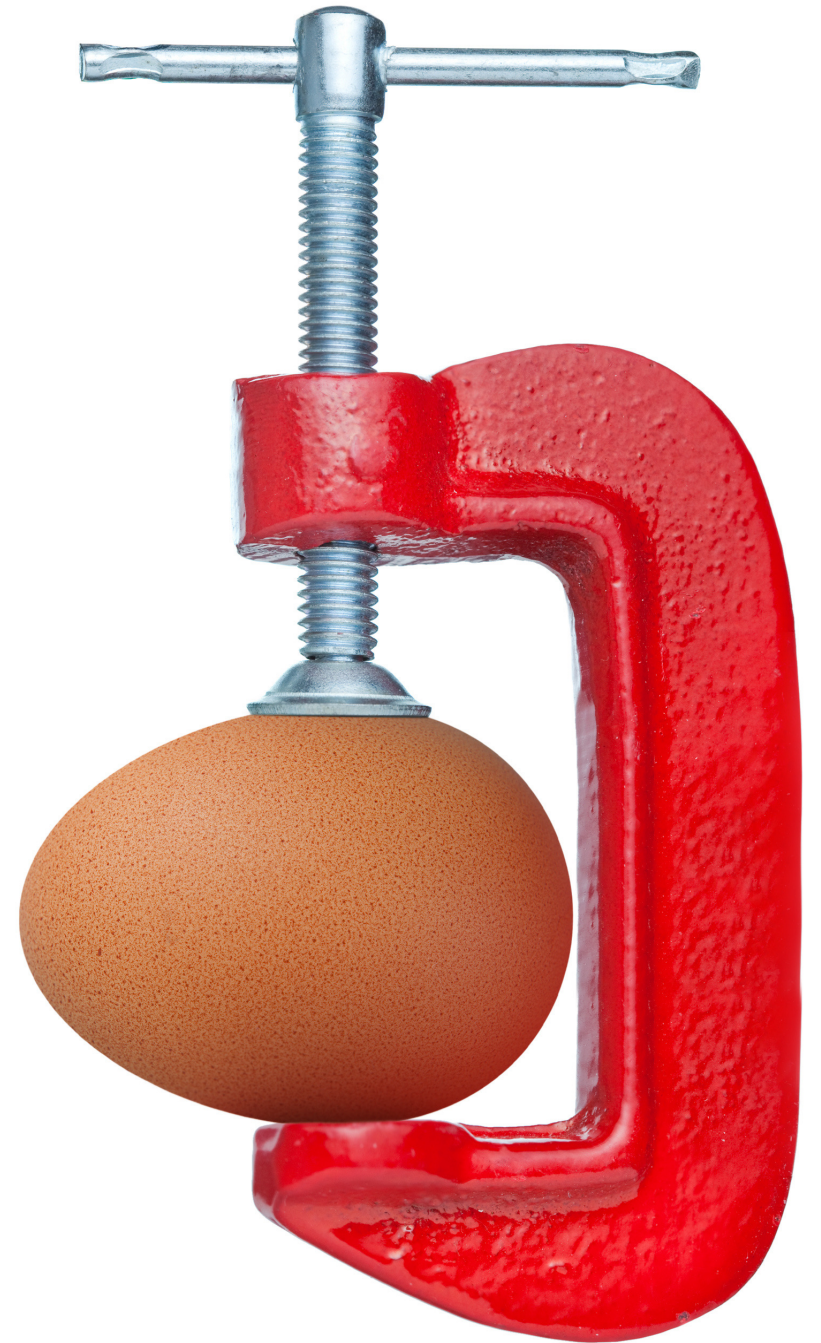
CVP

TISSUE PERFUSION





VOLUME DOESN'T
COUNT UNLESS
IT'S PRESSURIZED



Right Heart

Left Heart

Vena Cava

Pulmonary Artery

Aorta

LV CO

LV Afterload

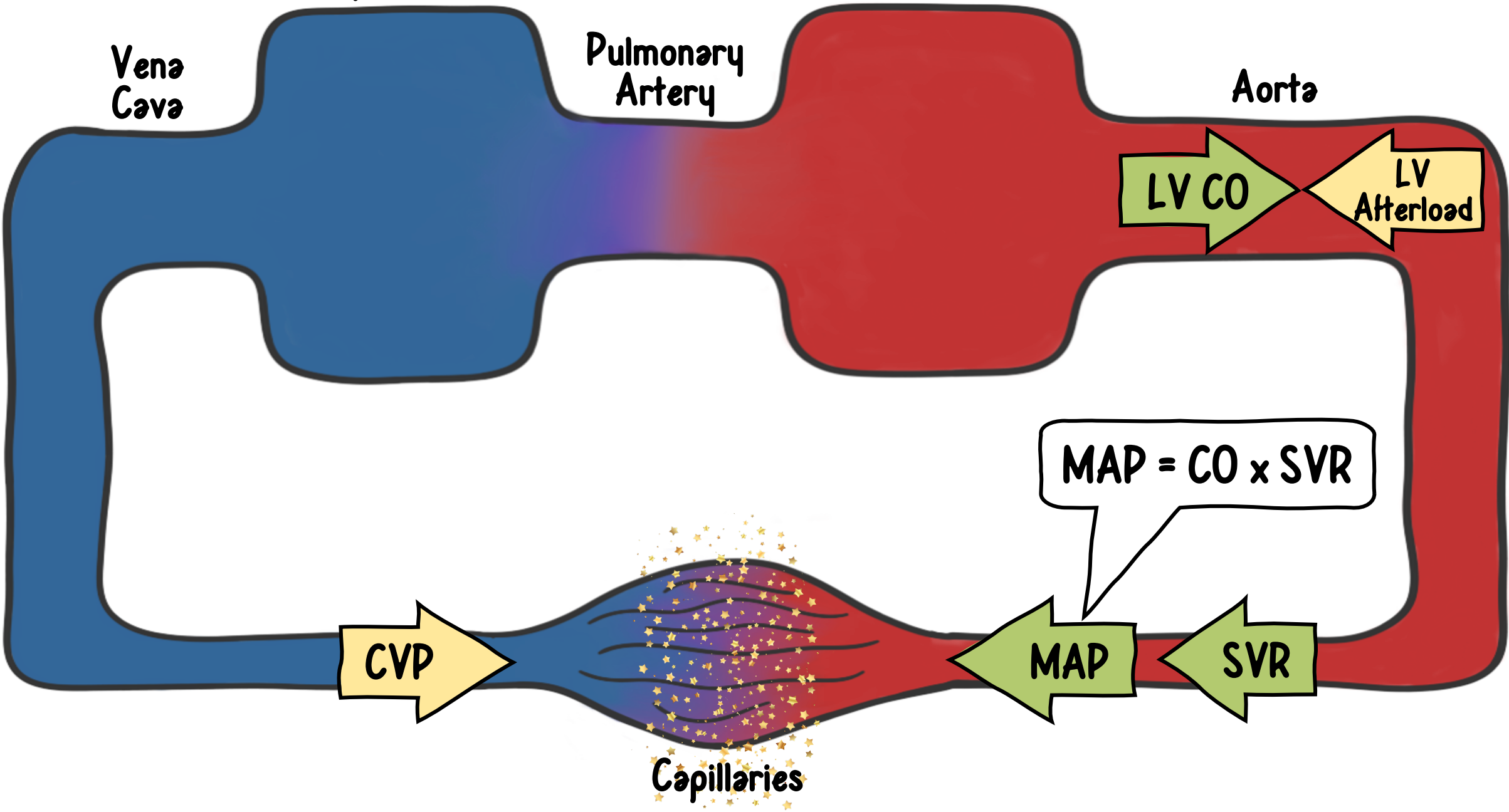
$$MAP = CO \times SVR$$

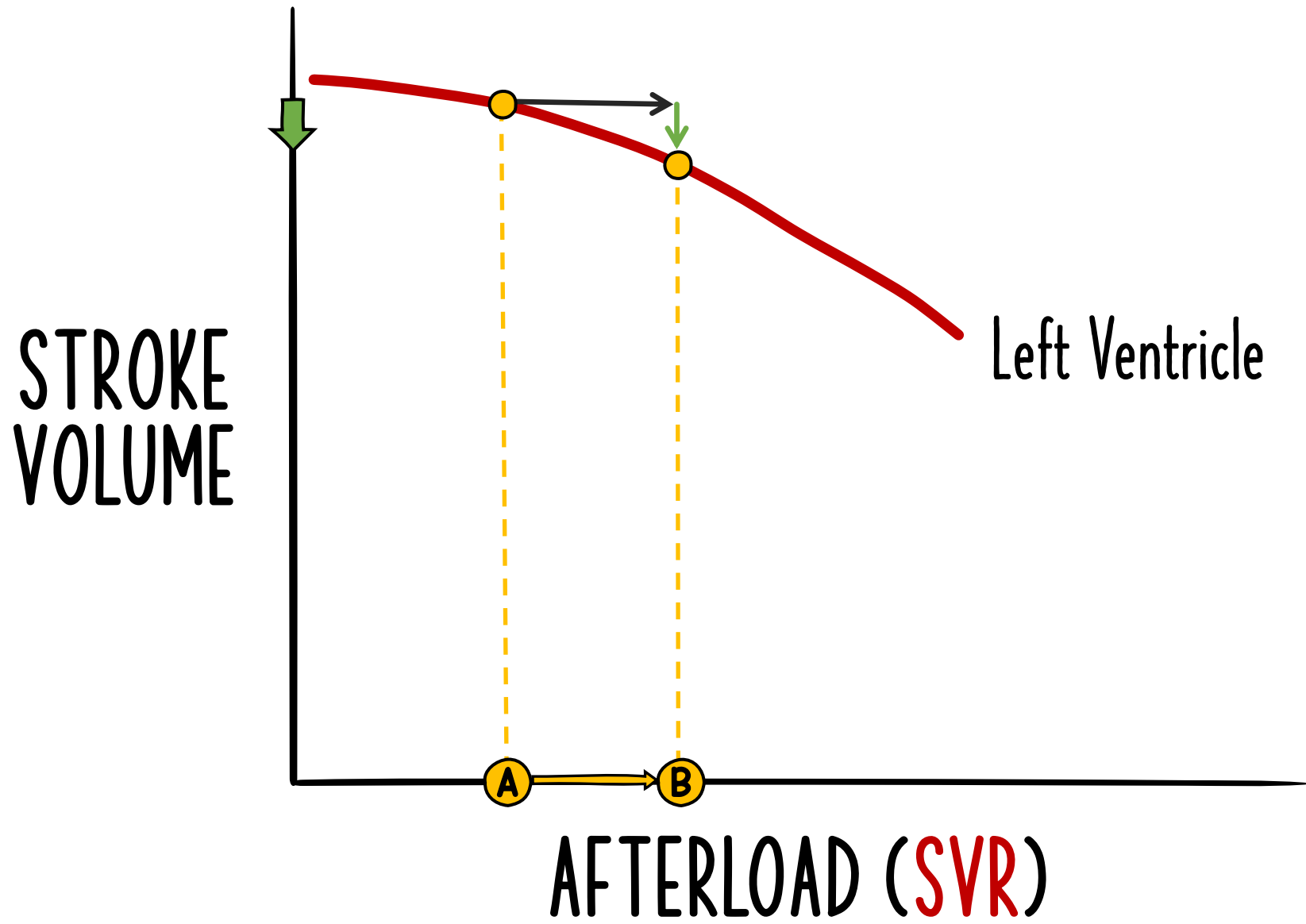
CVP

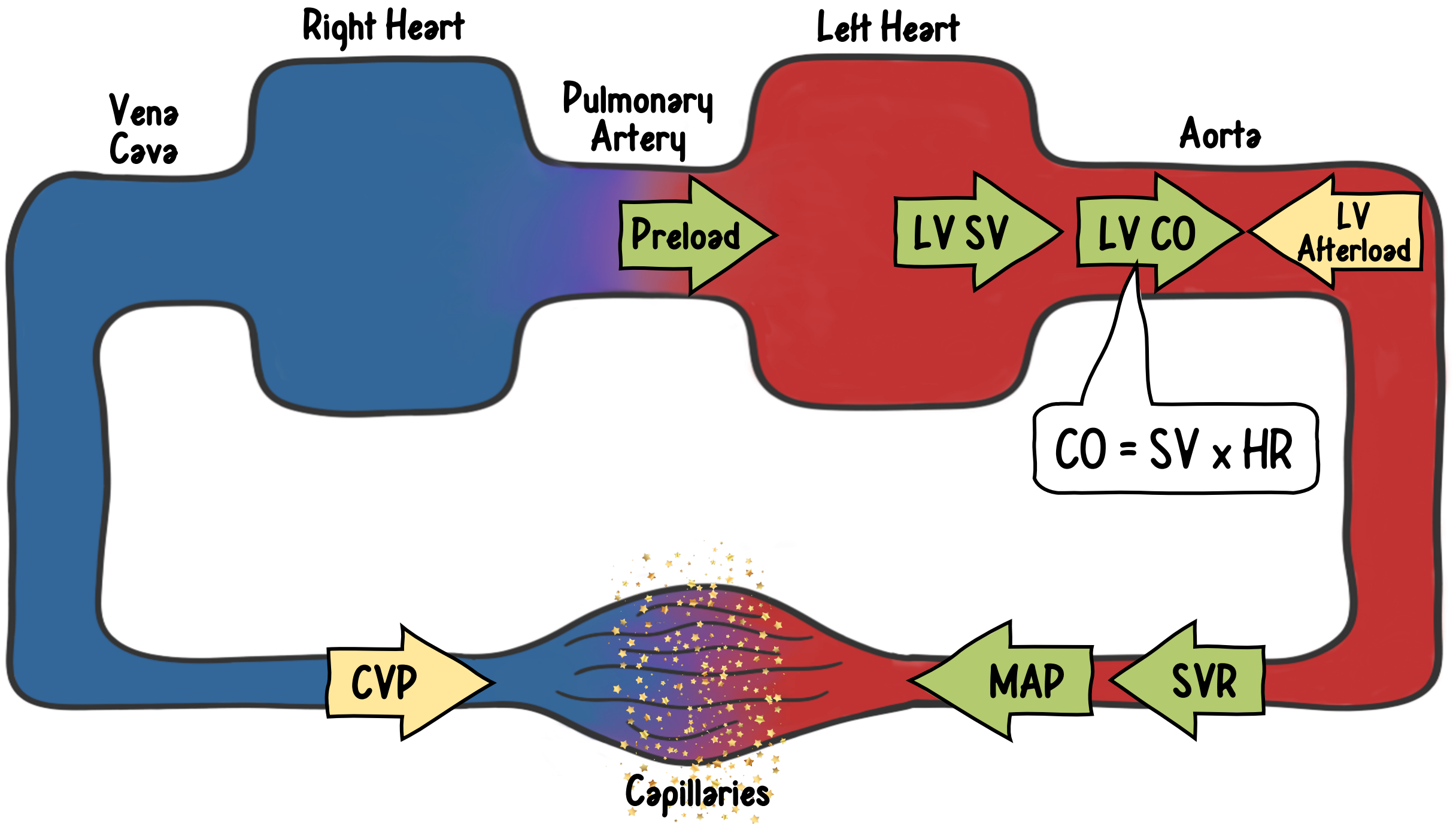
MAP

SVR

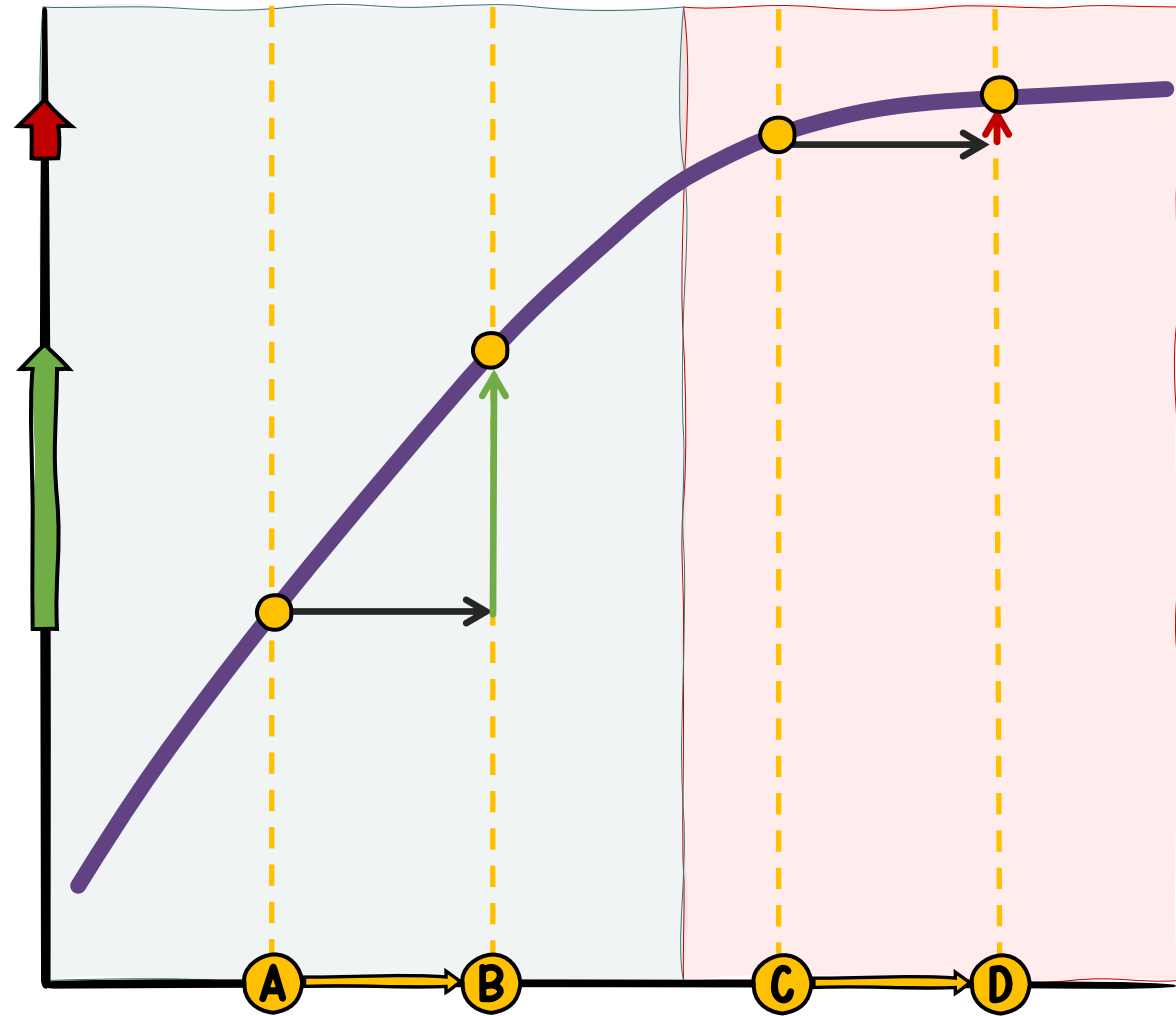
Capillaries





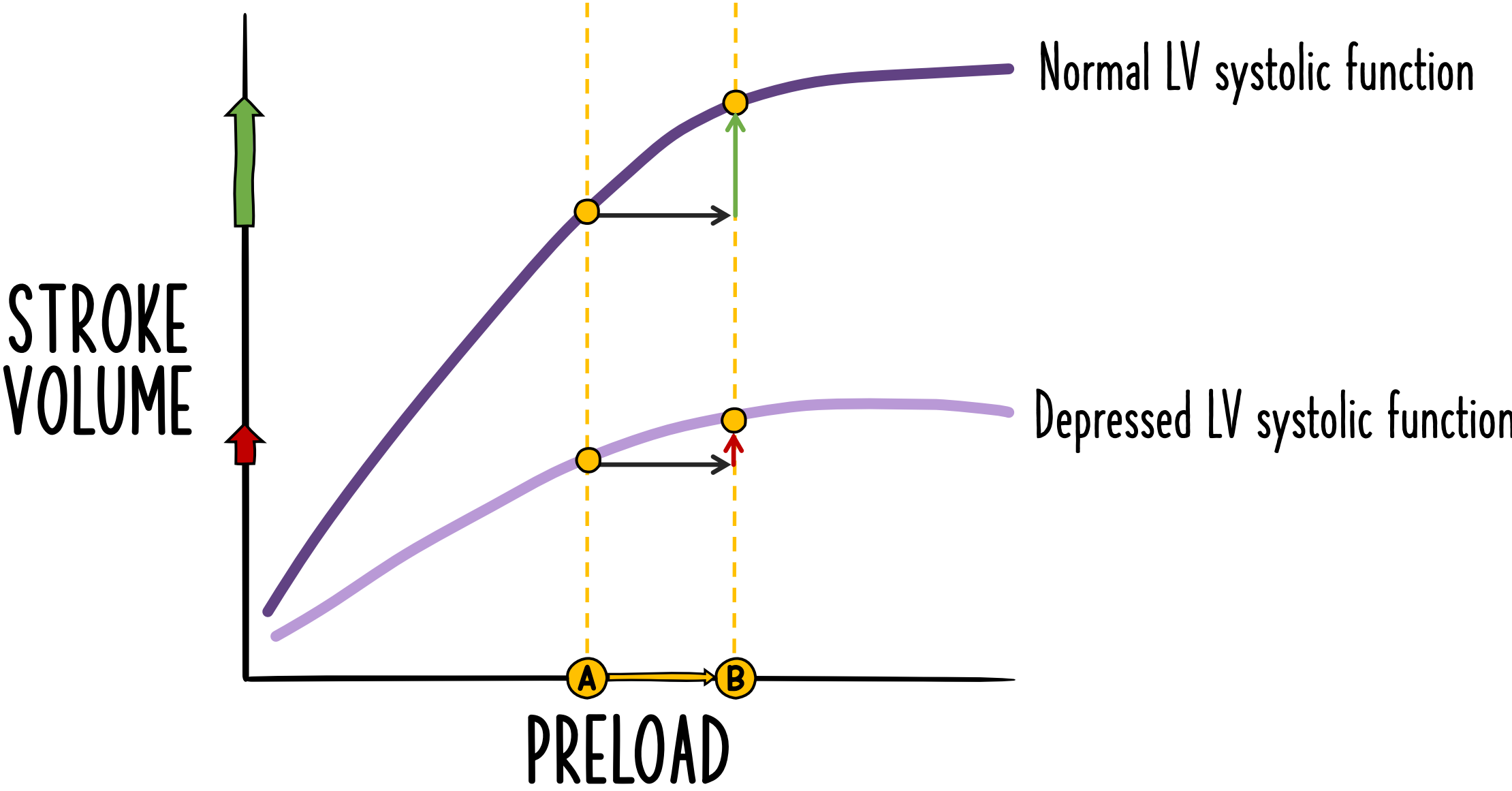


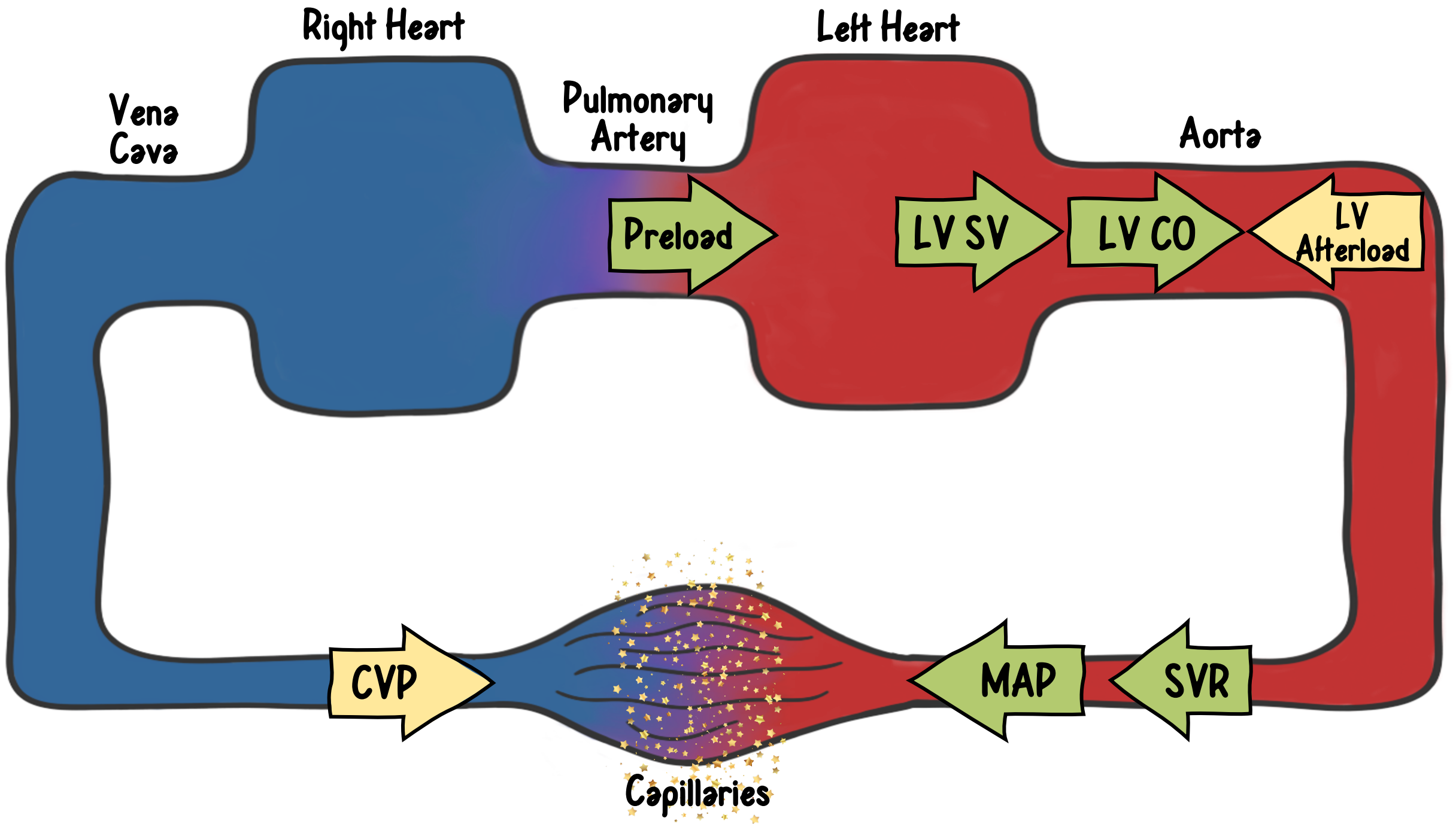
STROKE
VOLUME



PRELOAD

Normal LV systolic function

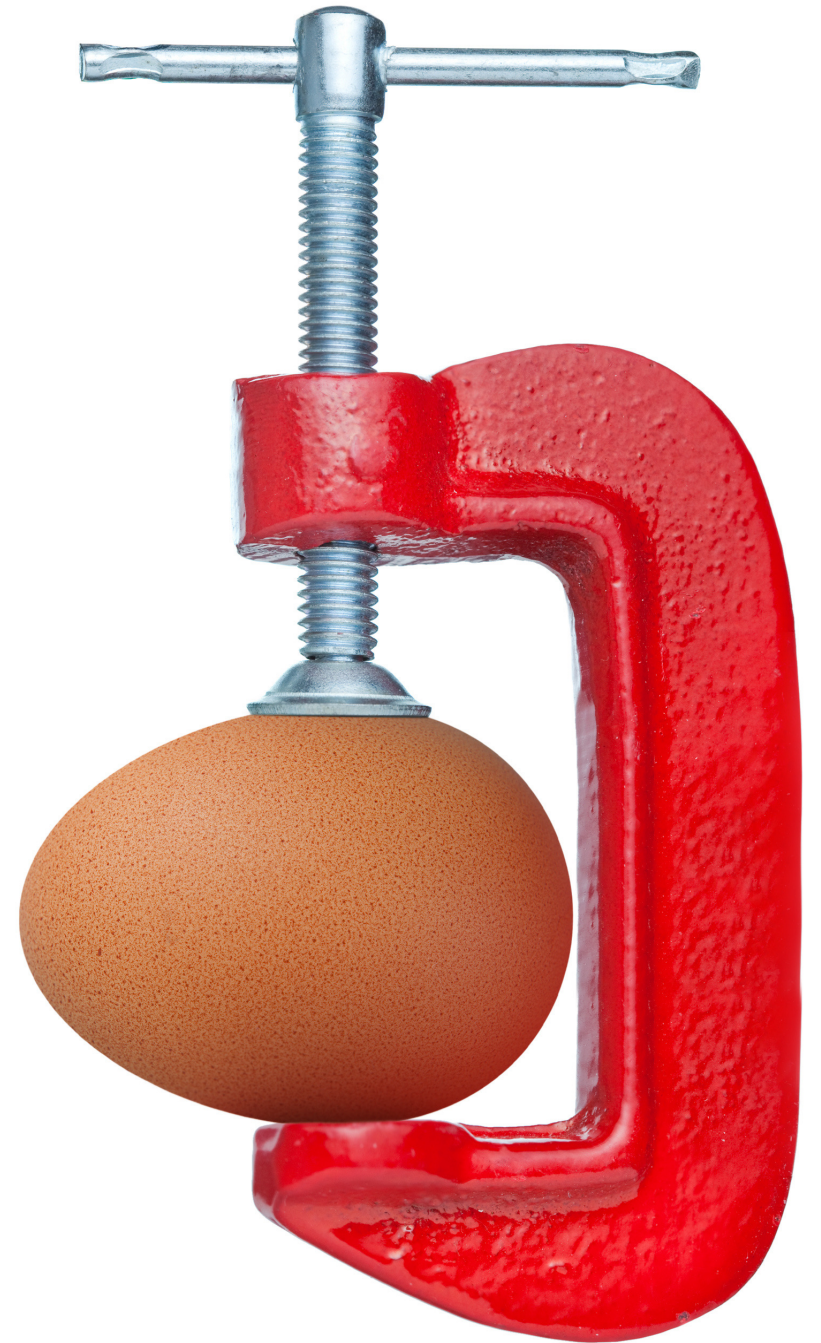






LOW PRELOAD
=
GIVE VOLUME?

VOLUME DOESN'T
COUNT UNLESS
IT'S PRESSURIZED



Right Heart

Left Heart

Vena Cava

Pulmonary Artery

Aorta

Filling Pressure

Preload

LV SV

LV CO

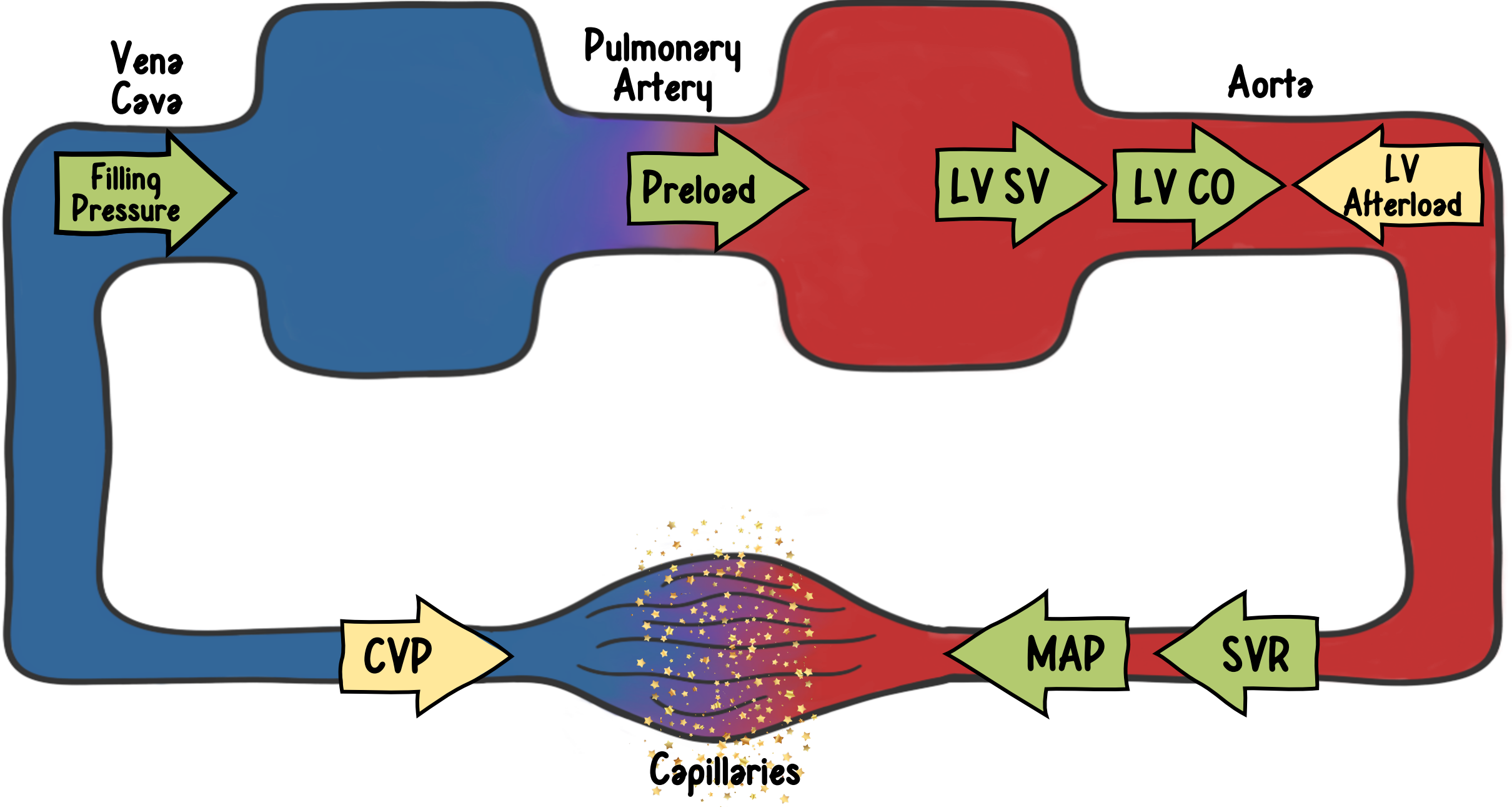
LV Afterload

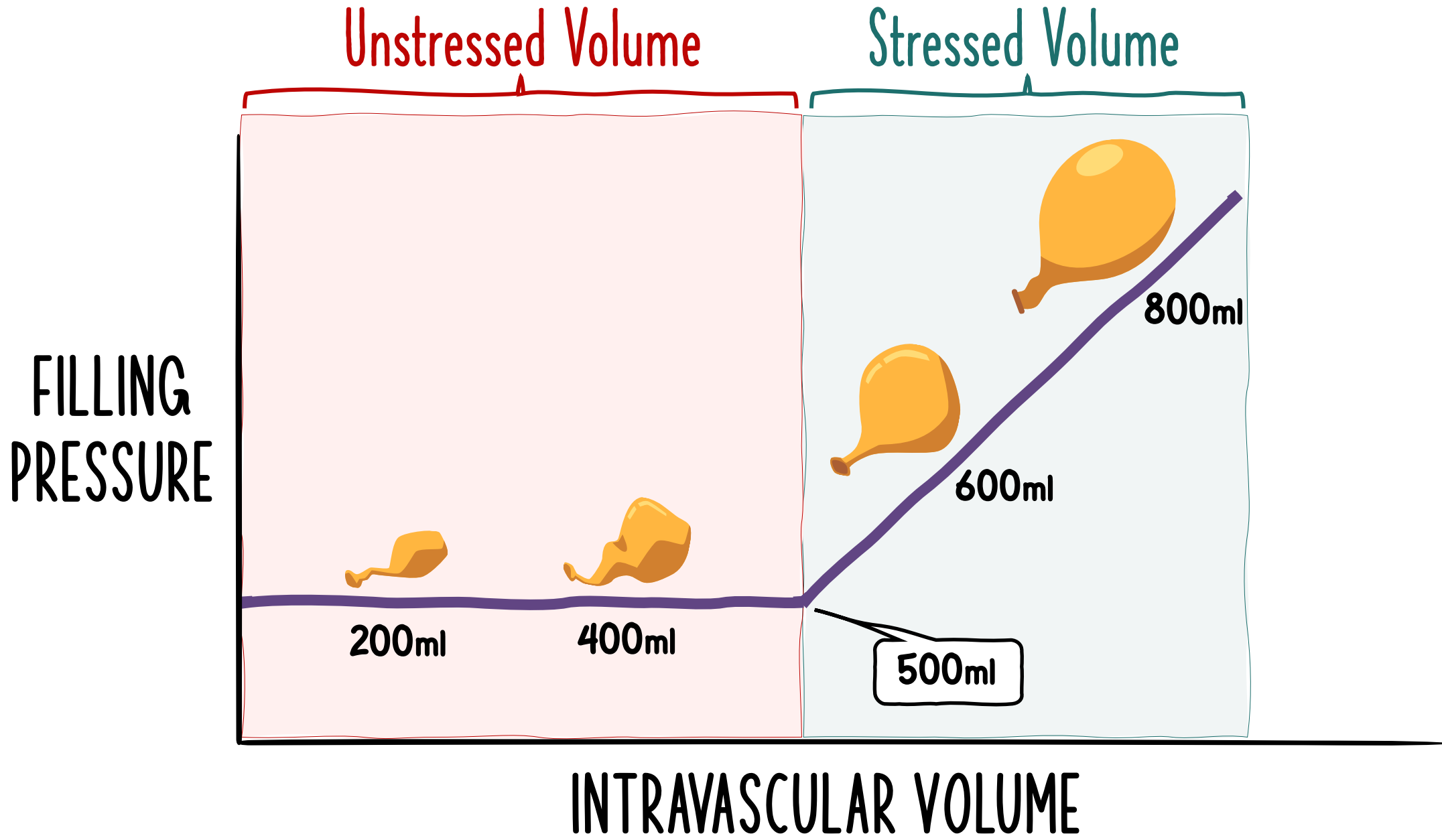
CVP

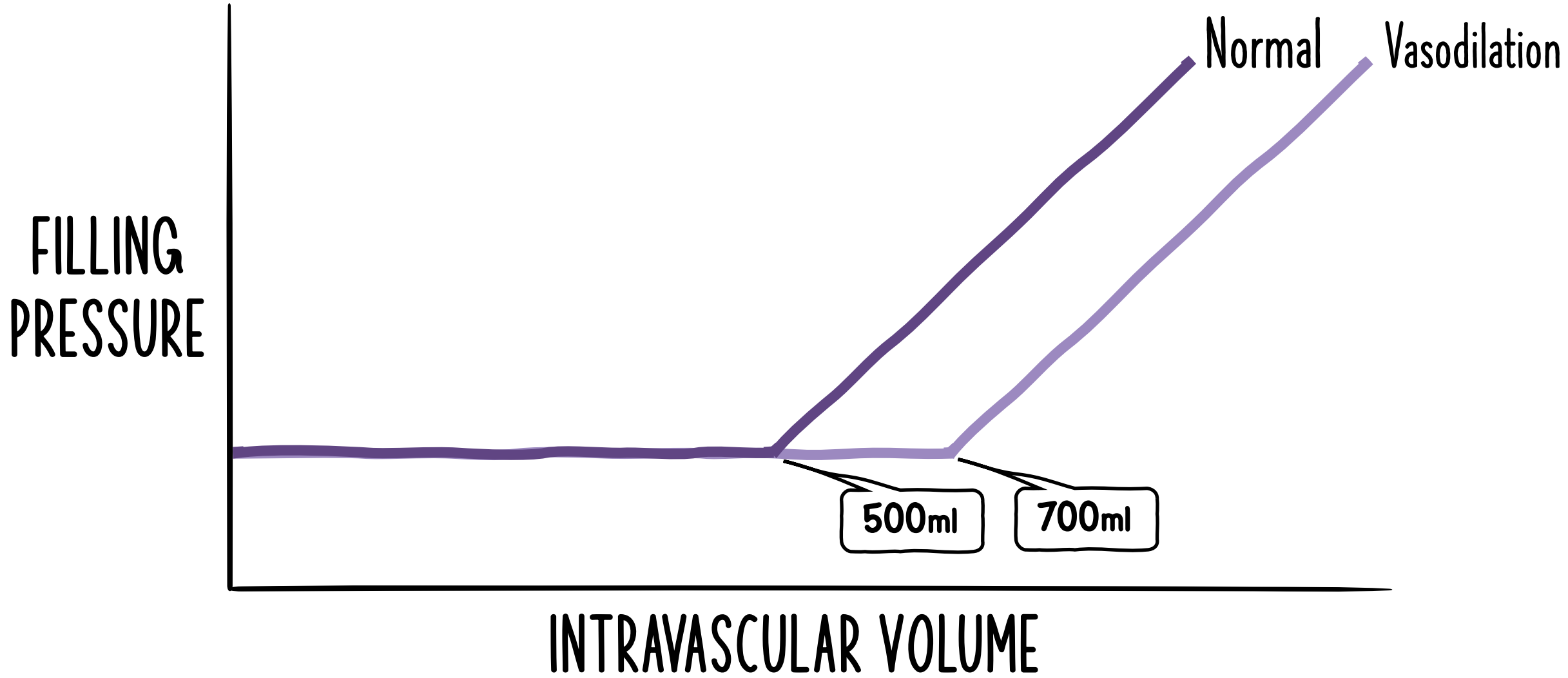
MAP

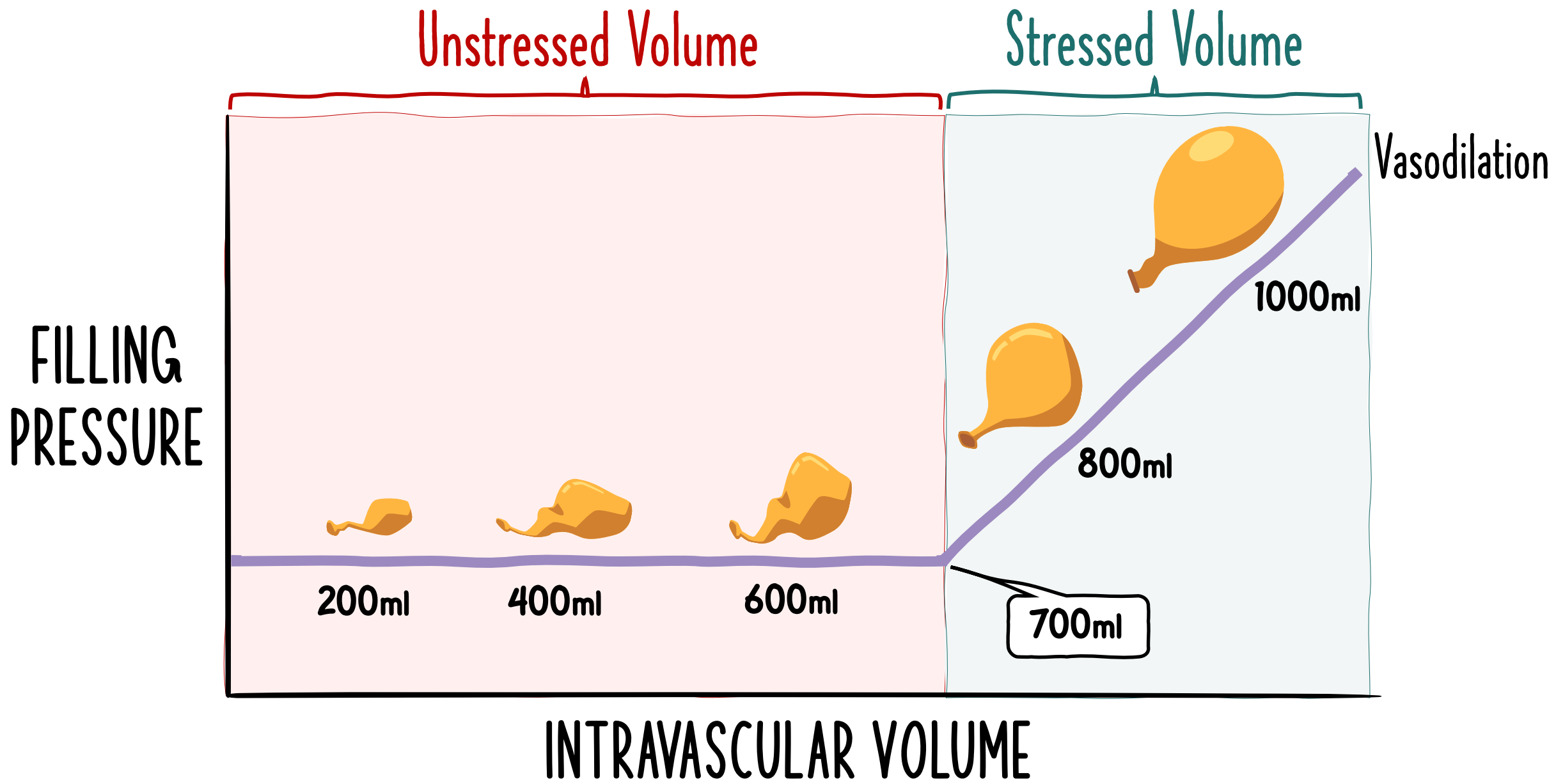
SVR

Capillaries









Right Heart

Left Heart

Vena Cava

Pulmonary Artery

Aorta

Filling Pressure

RV CO

RV Afterload

Preload

LV SV

LV CO

LV Afterload

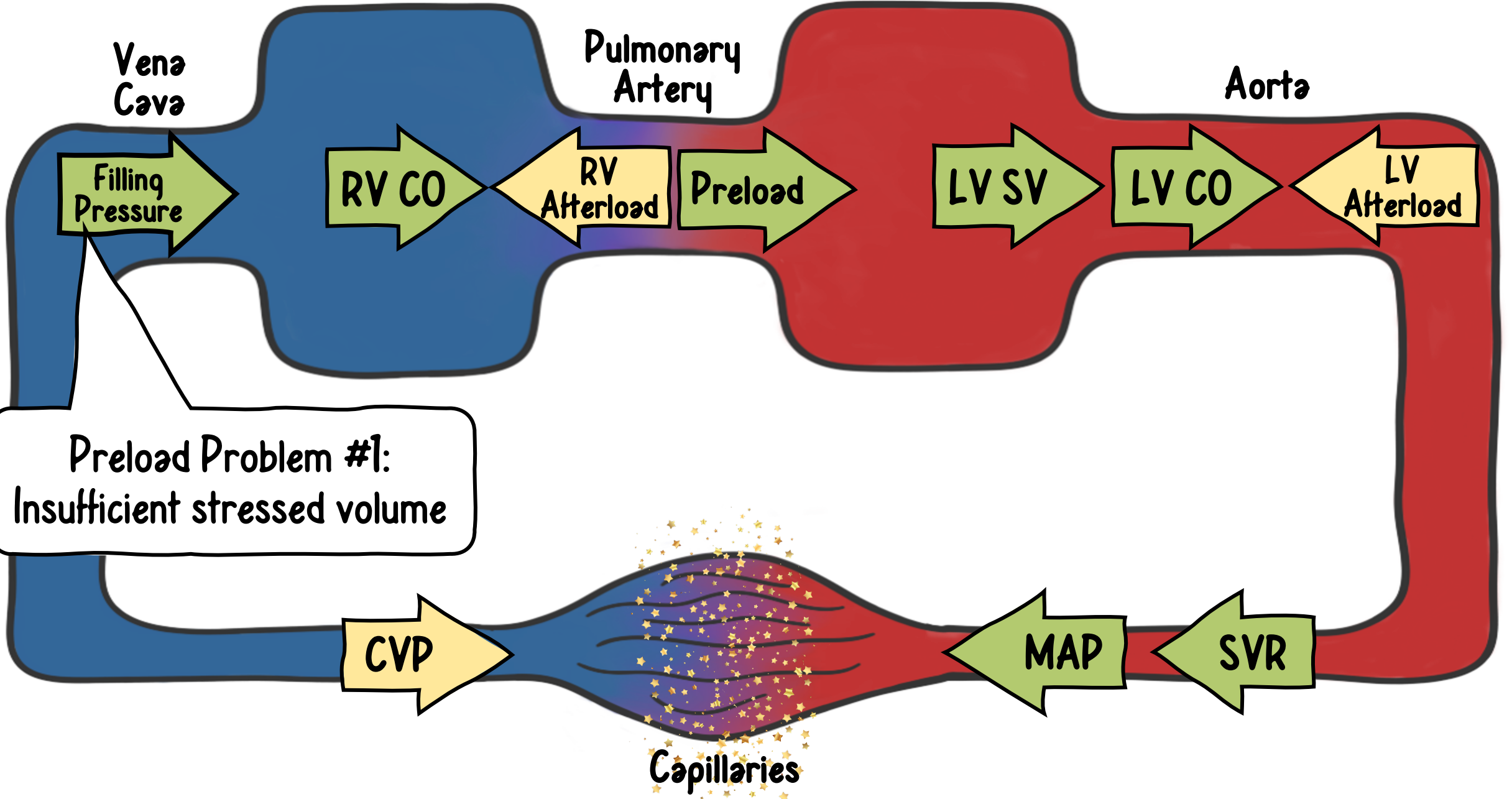
Preload Problem #1:
Insufficient stressed volume

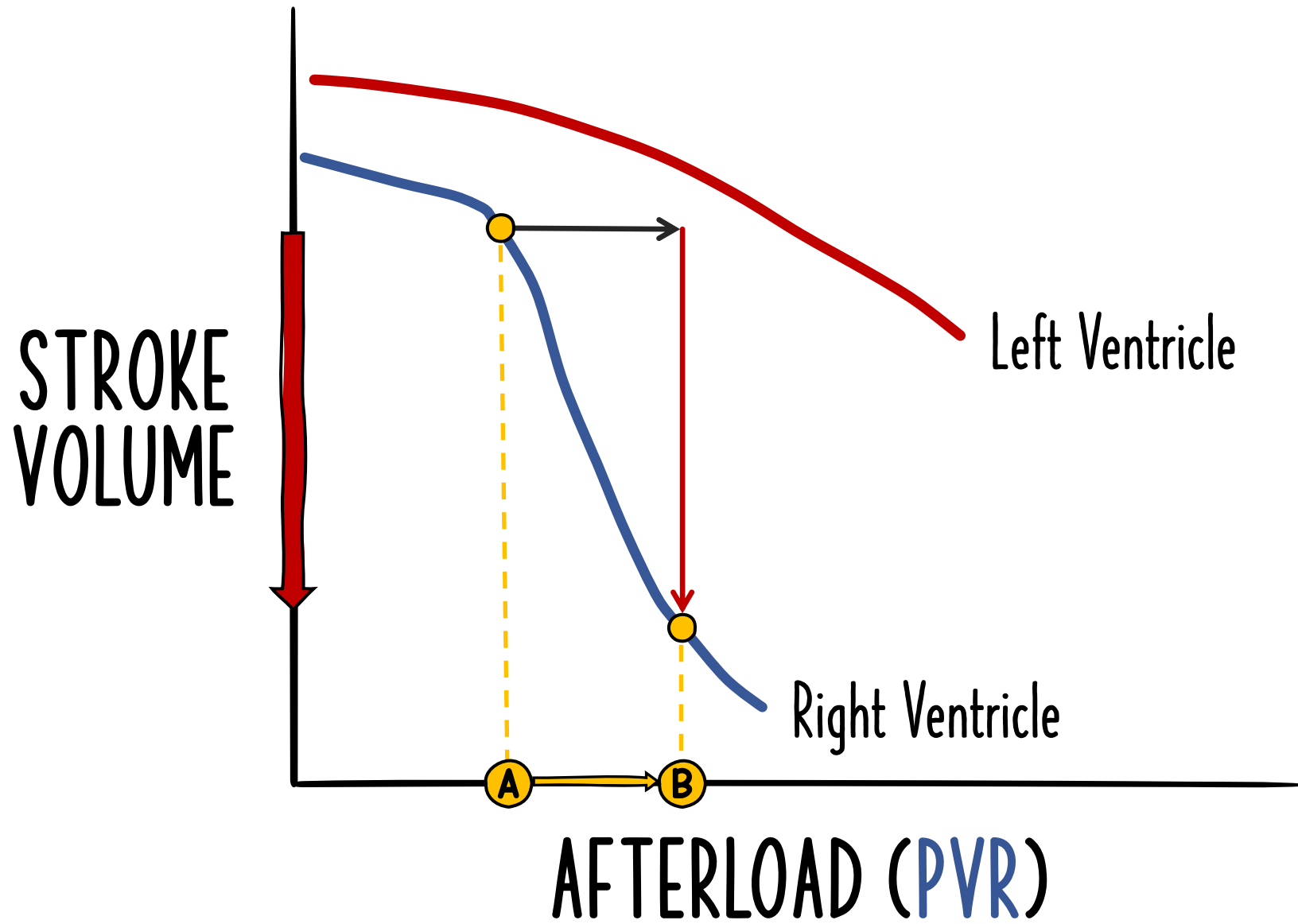
CVP

MAP

SVR

Capillaries





Right Heart

Left Heart

Vena Cava

Pulmonary Artery

Aorta

Filling Pressure

RV CO

RV Afterload

Preload

LVEDP

LV SV

LV CO

LV Afterload

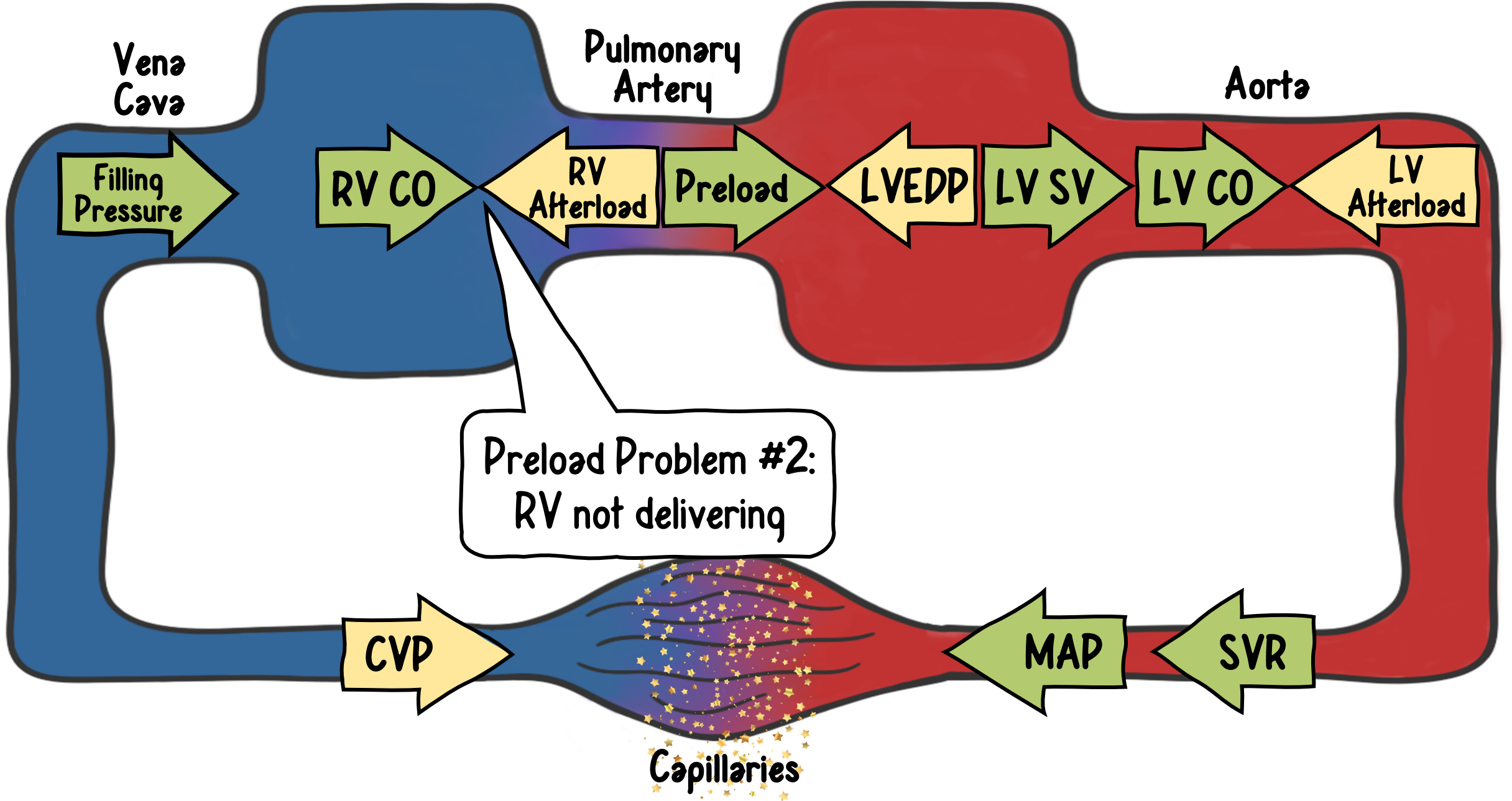
Preload Problem #2:
RV not delivering

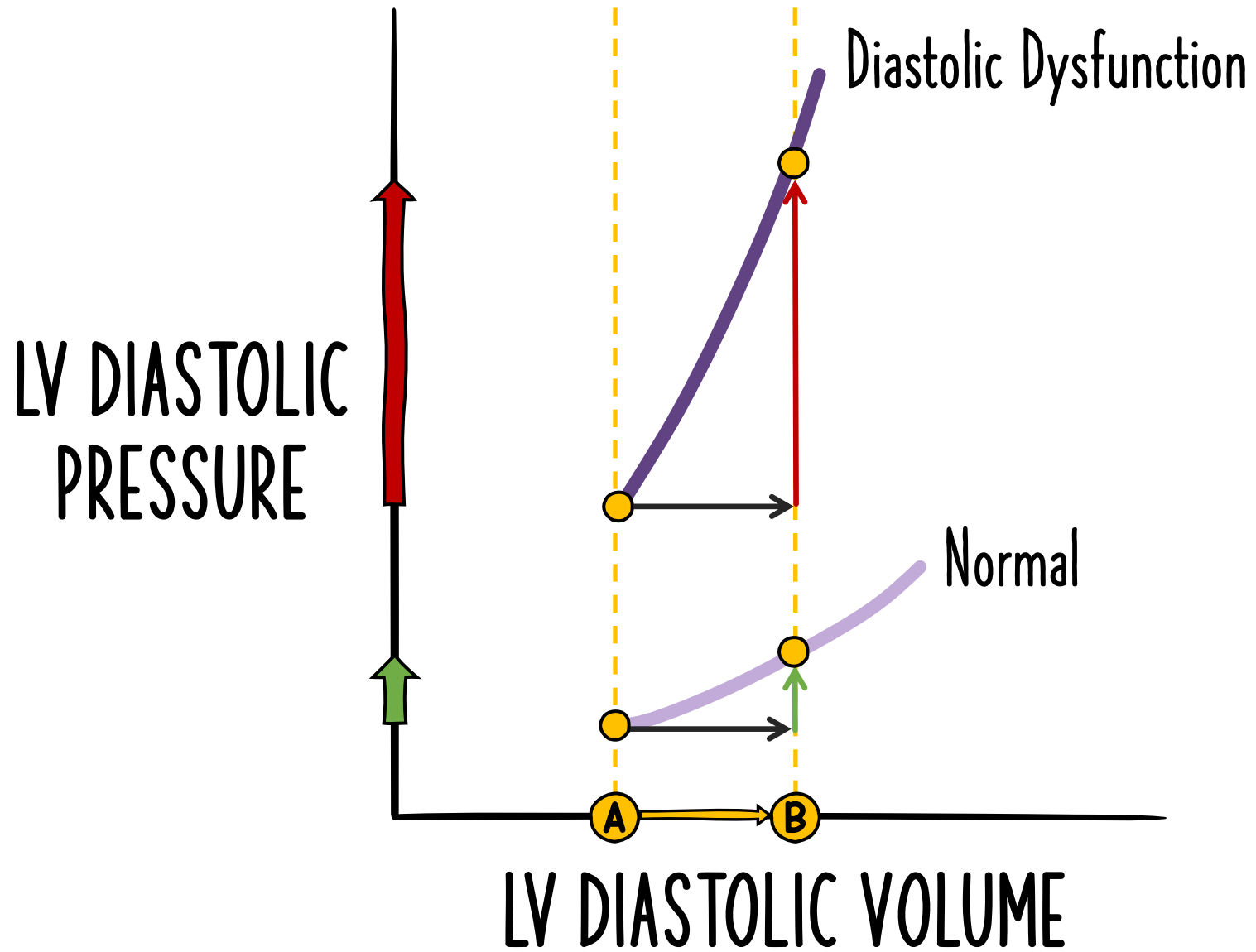
CVP

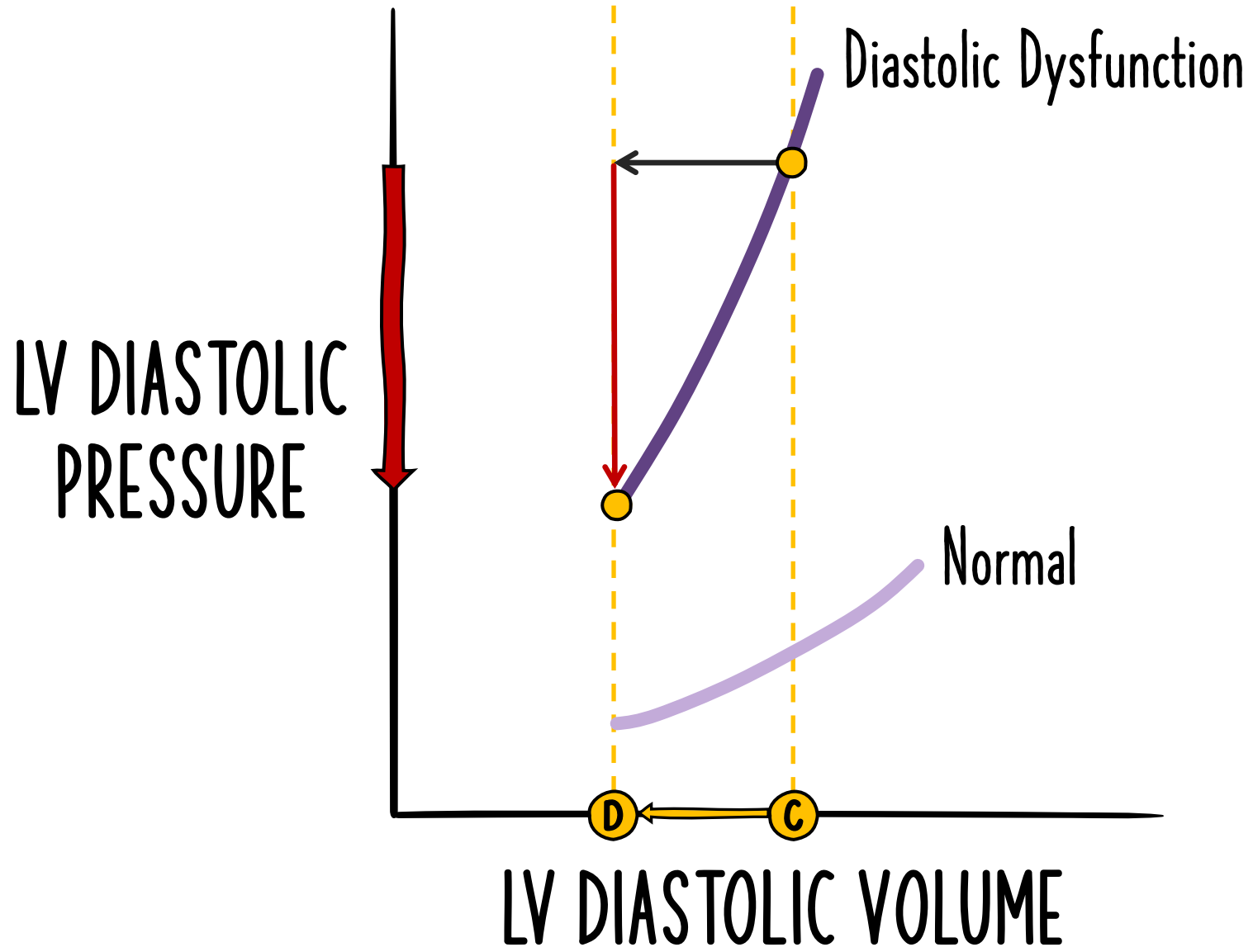
MAP

SVR

Capillaries







Right Heart

Left Heart

Vena Cava

Pulmonary Artery

Aorta

Filling Pressure

RAP

RV CO

RV Afterload

Preload

LVEDP

LV SV

LV CO

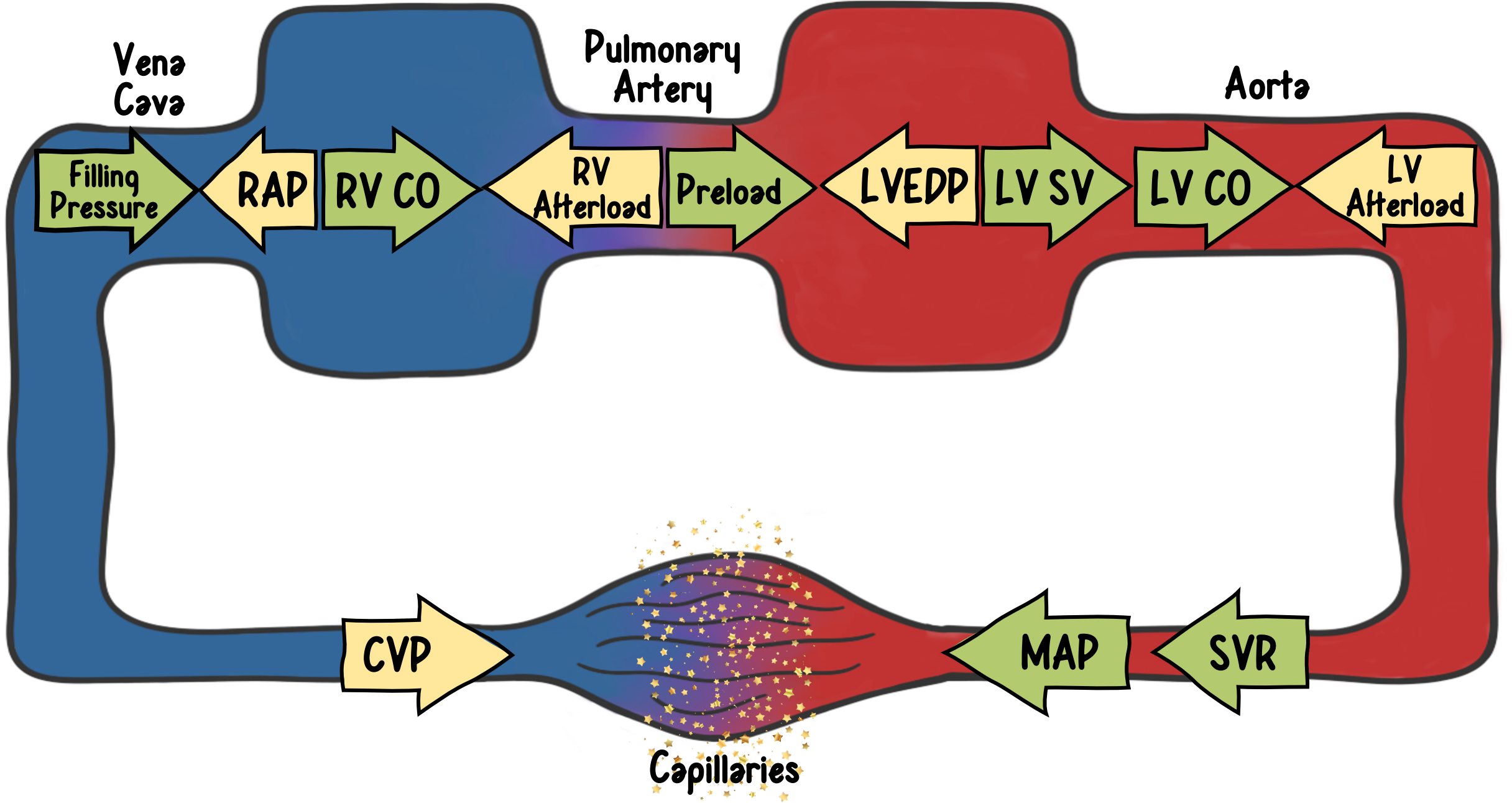
LV Afterload

CVP

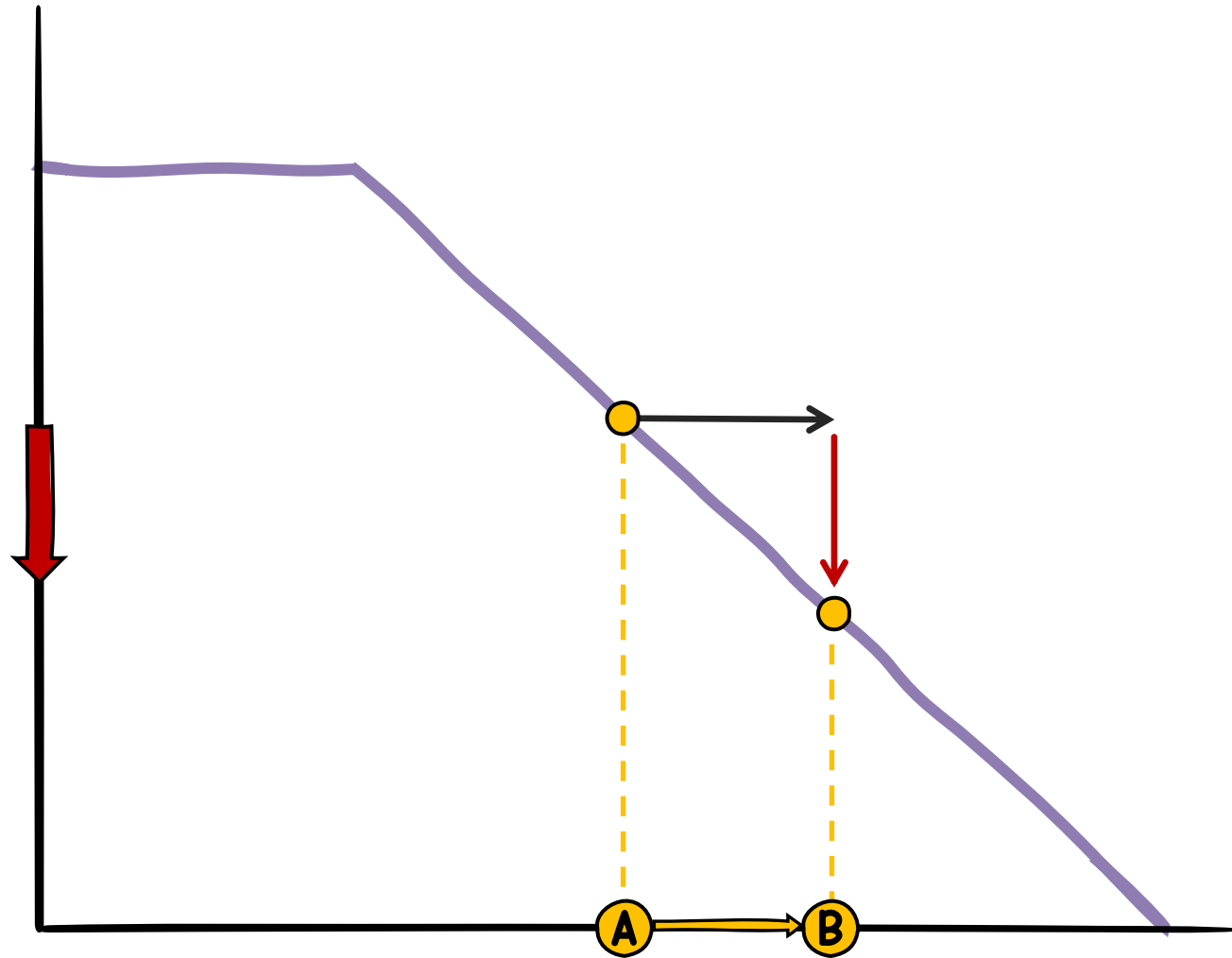
MAP

SVR

Capillaries

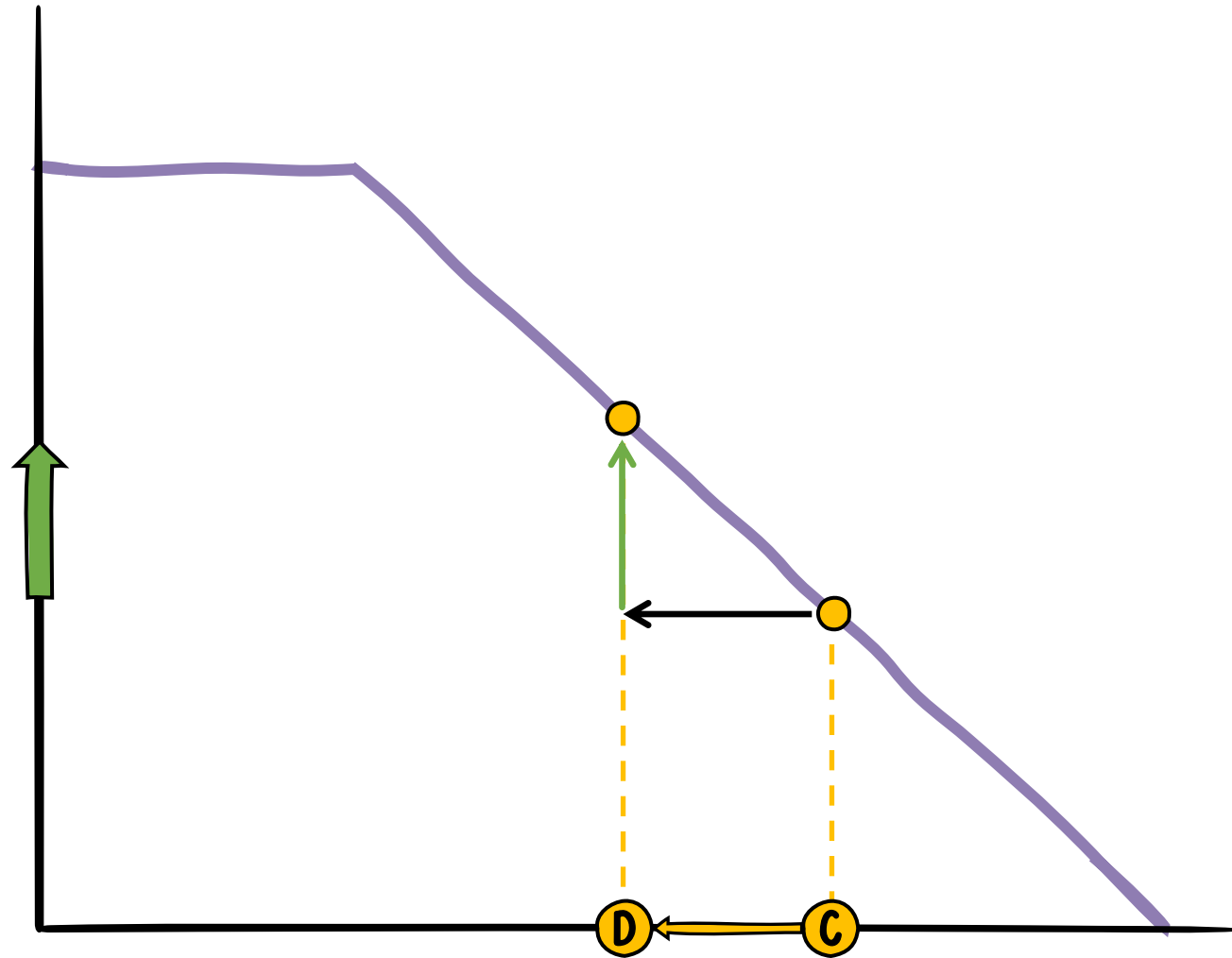


VENOUS
RETURN



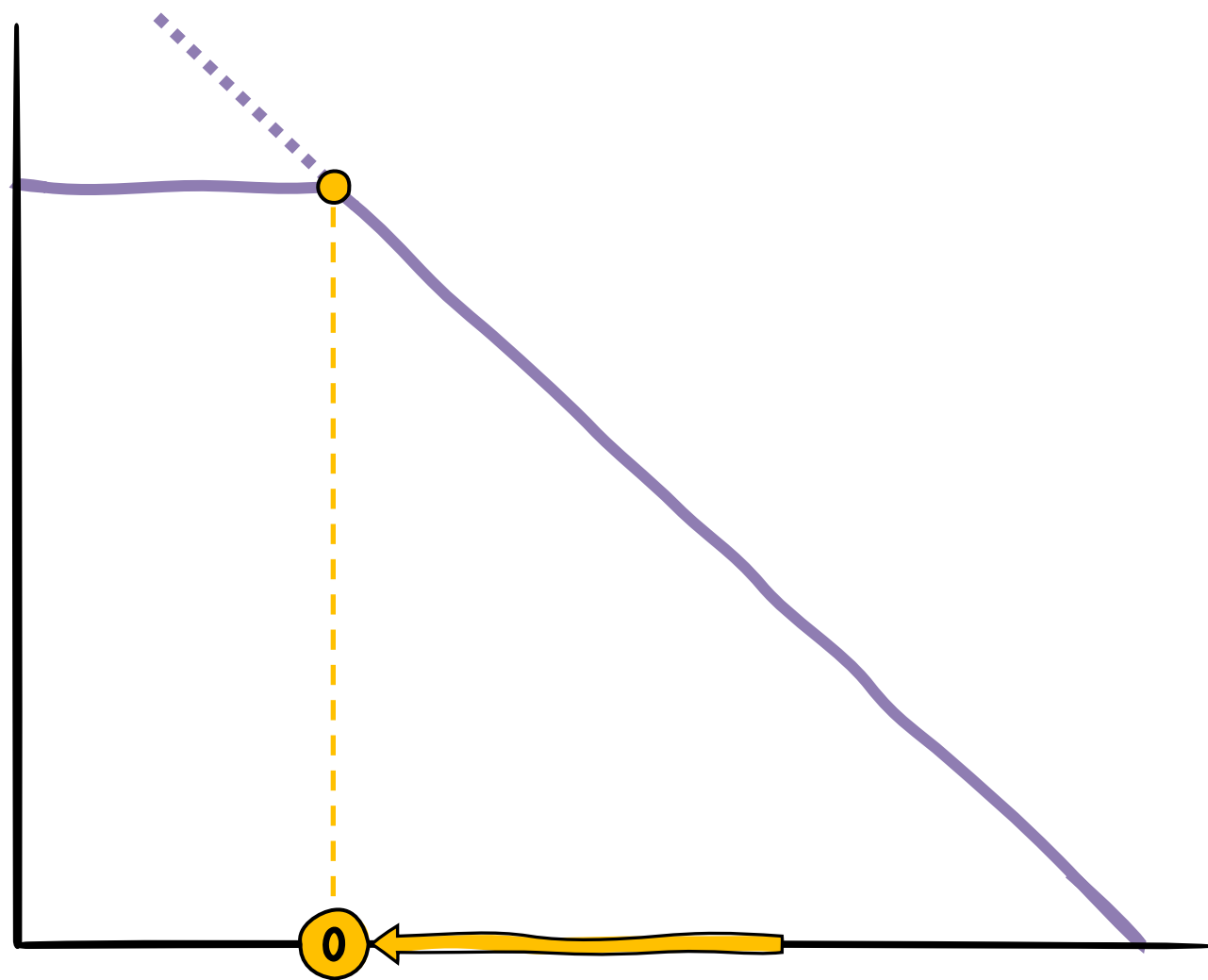
RIGHT ATRIAL PRESSURE

VENOUS
RETURN



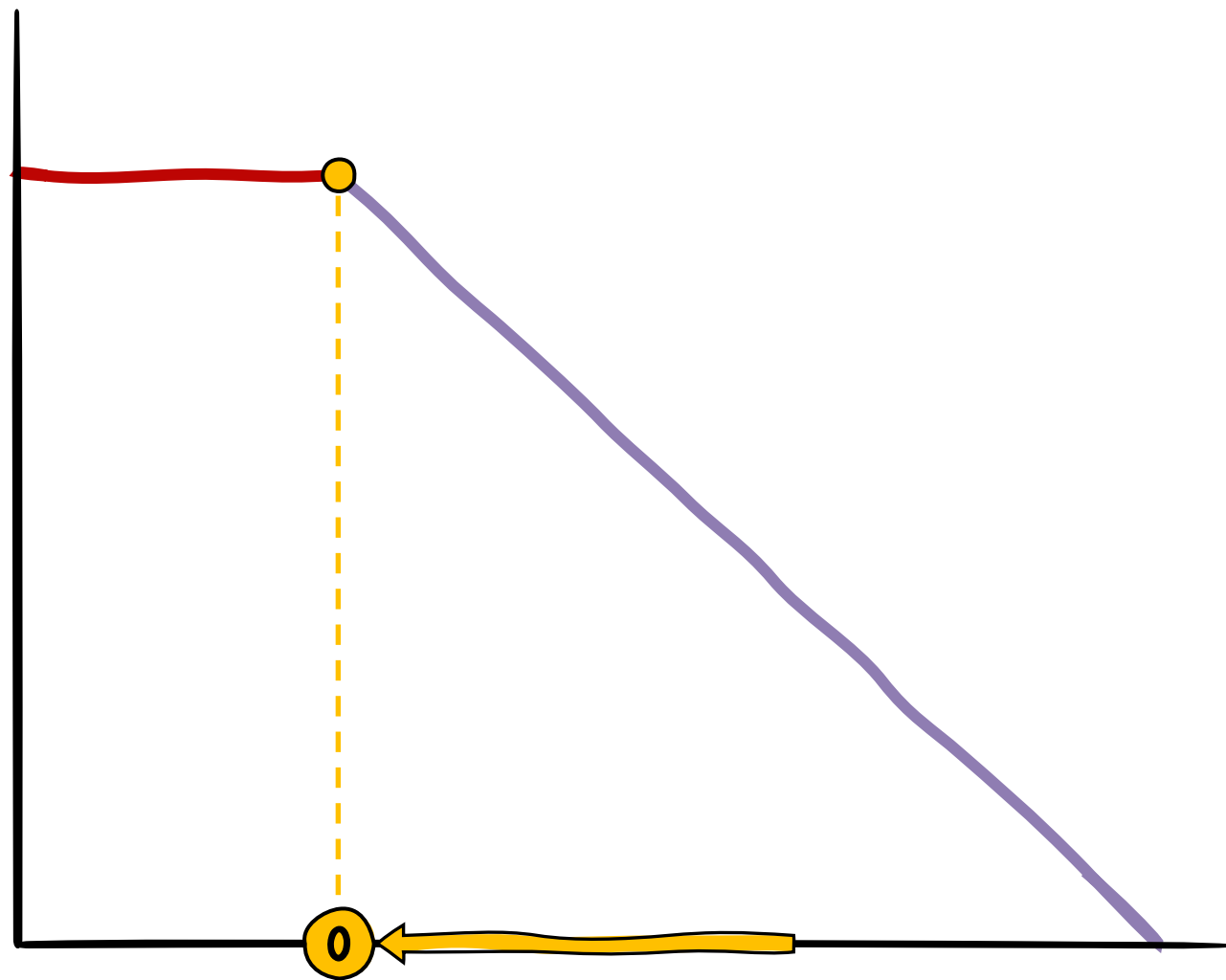
RIGHT ATRIAL PRESSURE

VENOUS
RETURN

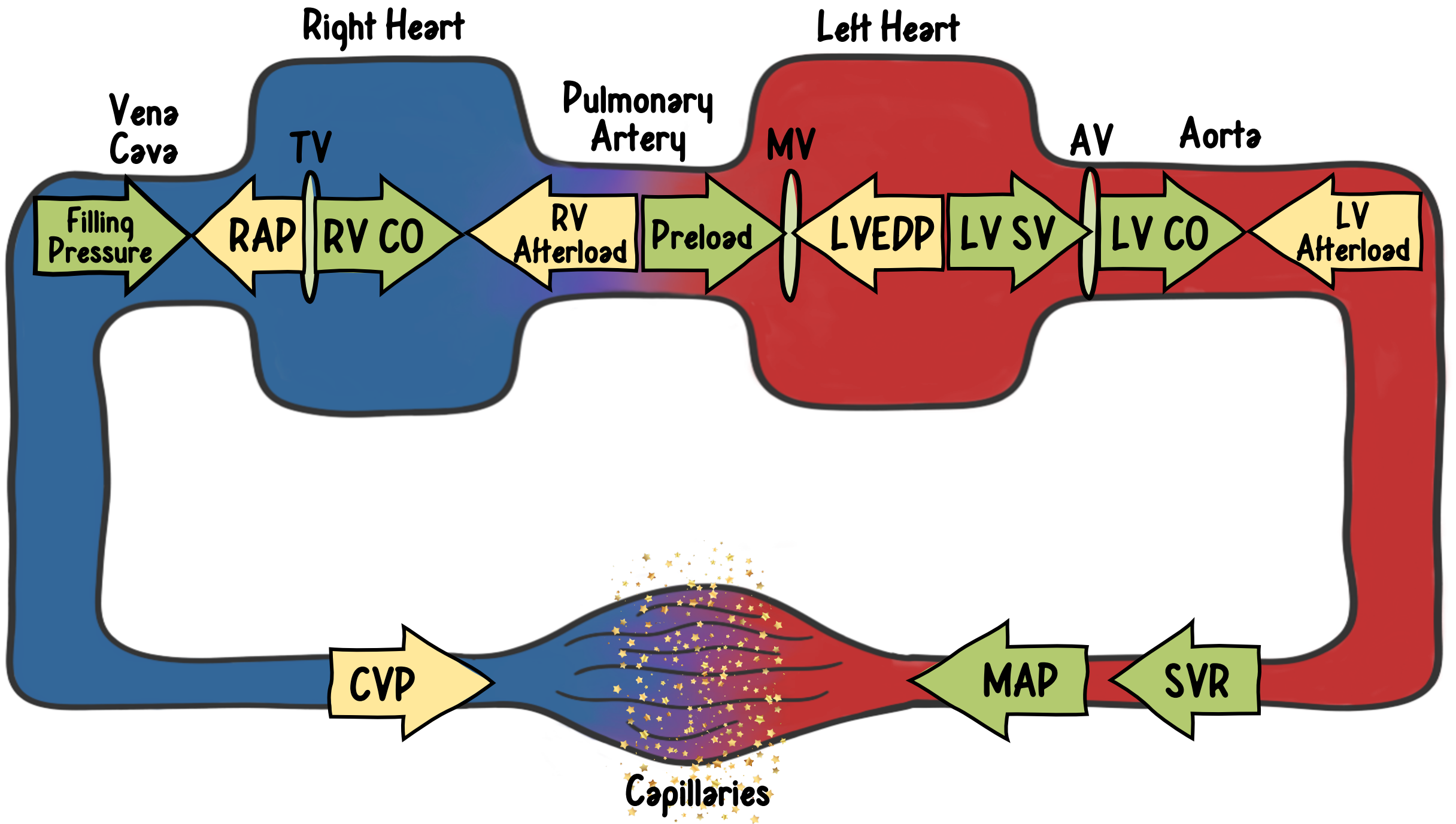


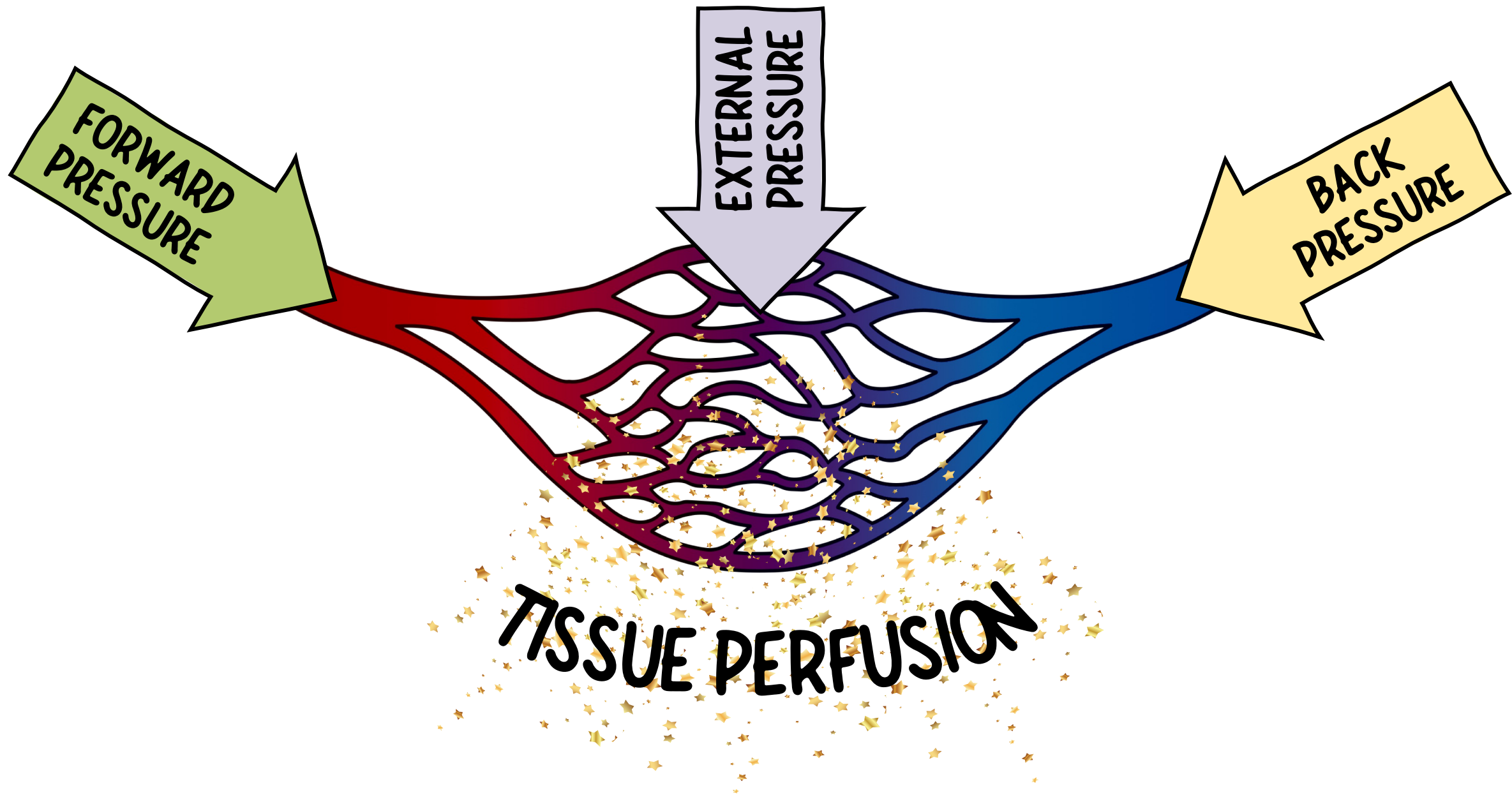
RIGHT ATRIAL PRESSURE

VENOUS
RETURN



RIGHT ATRIAL PRESSURE





FORWARD
PRESSURE

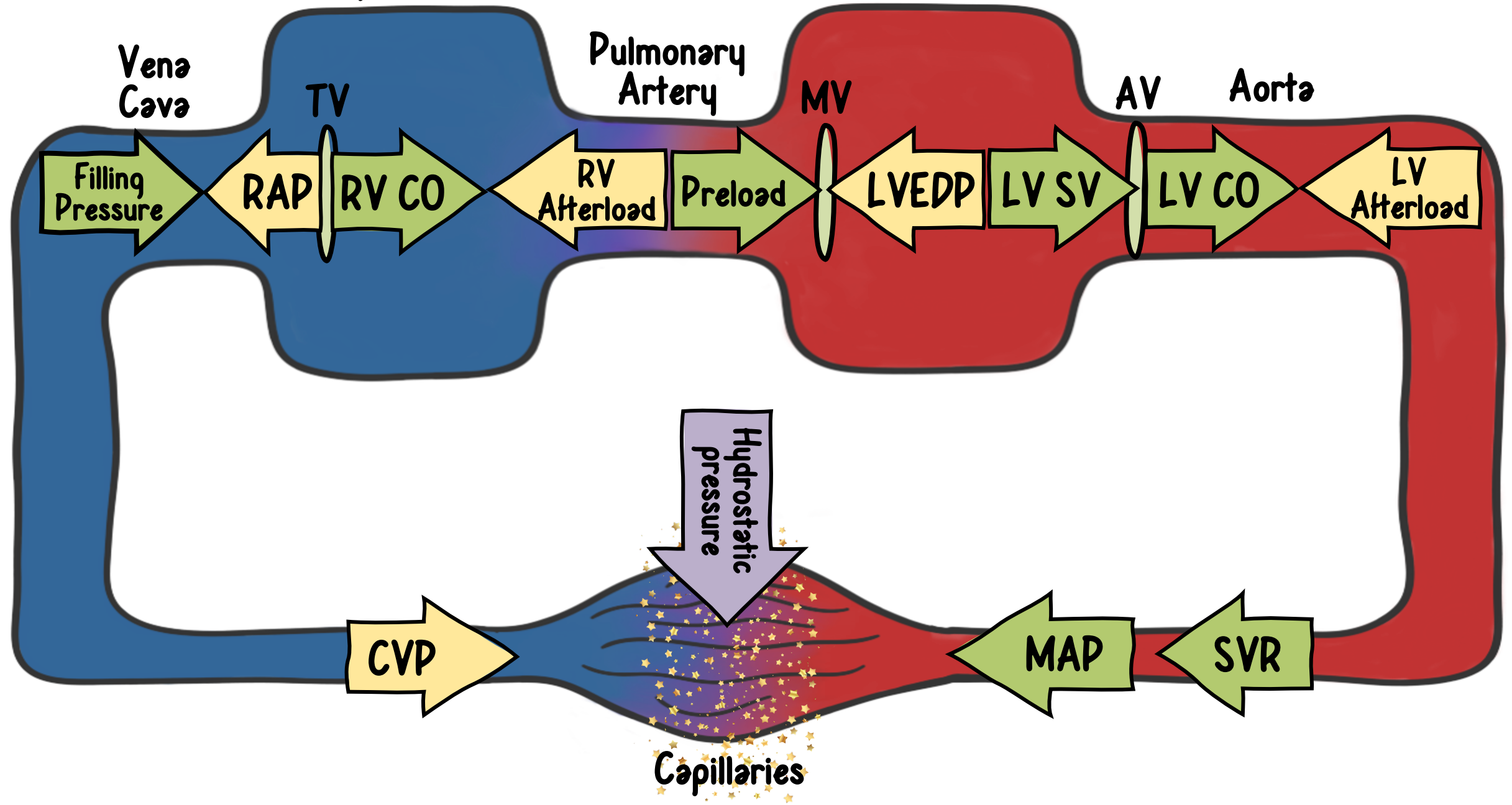
EXTERNAL
PRESSURE

BACK
PRESSURE

TISSUE PERFUSION

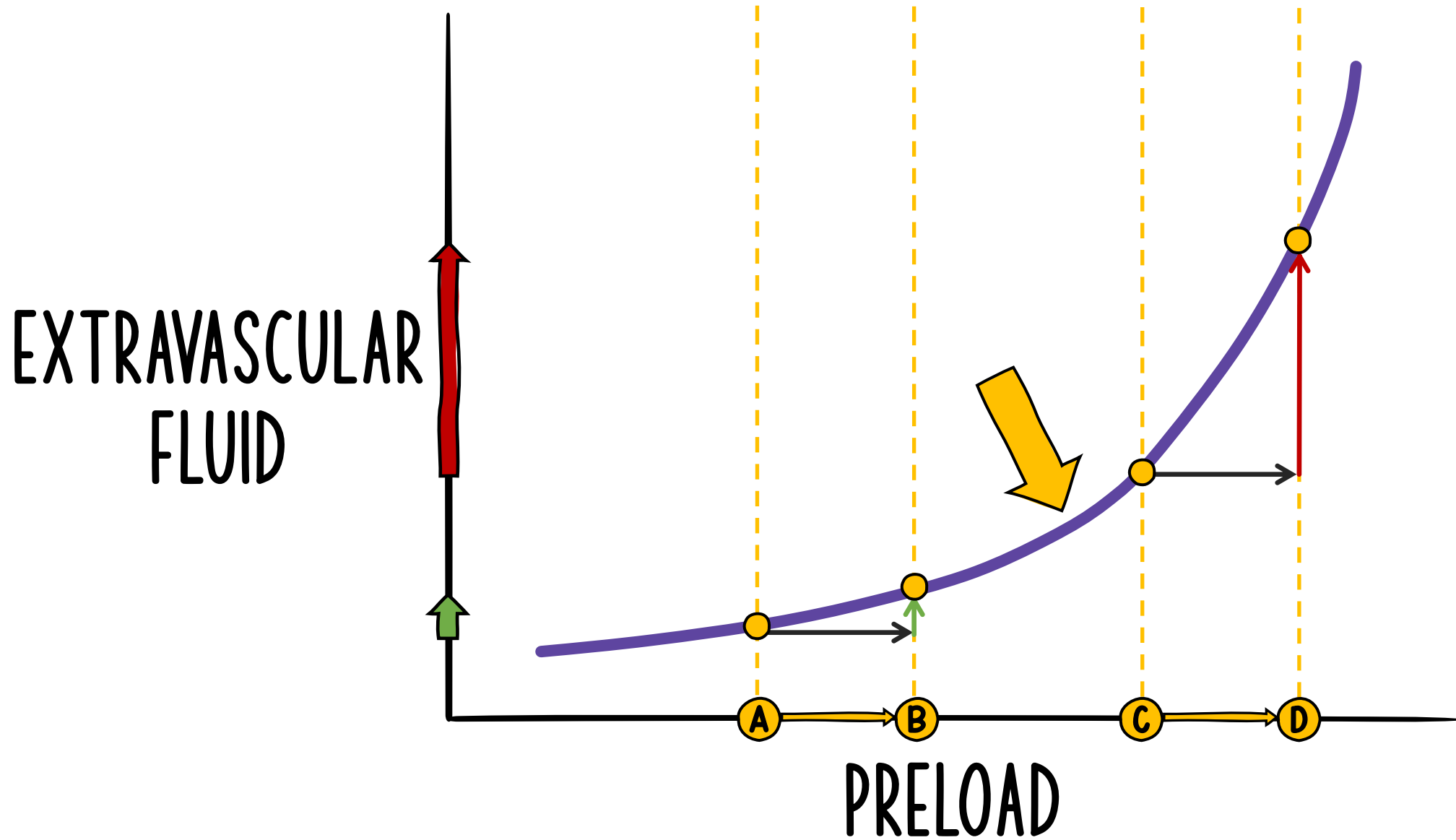
Right Heart

Left Heart

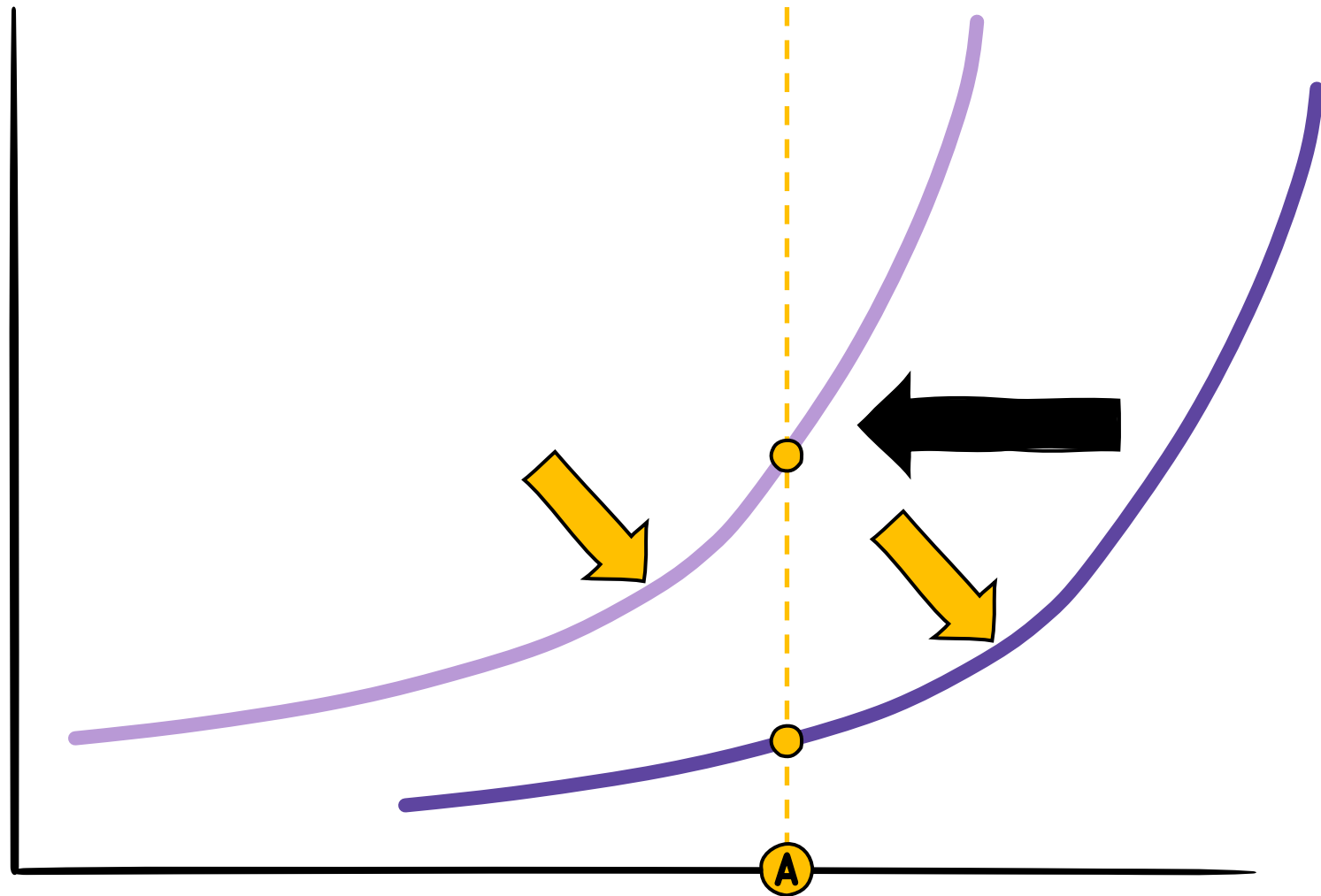


TISSUE HYDROSTATIC PRESSURE

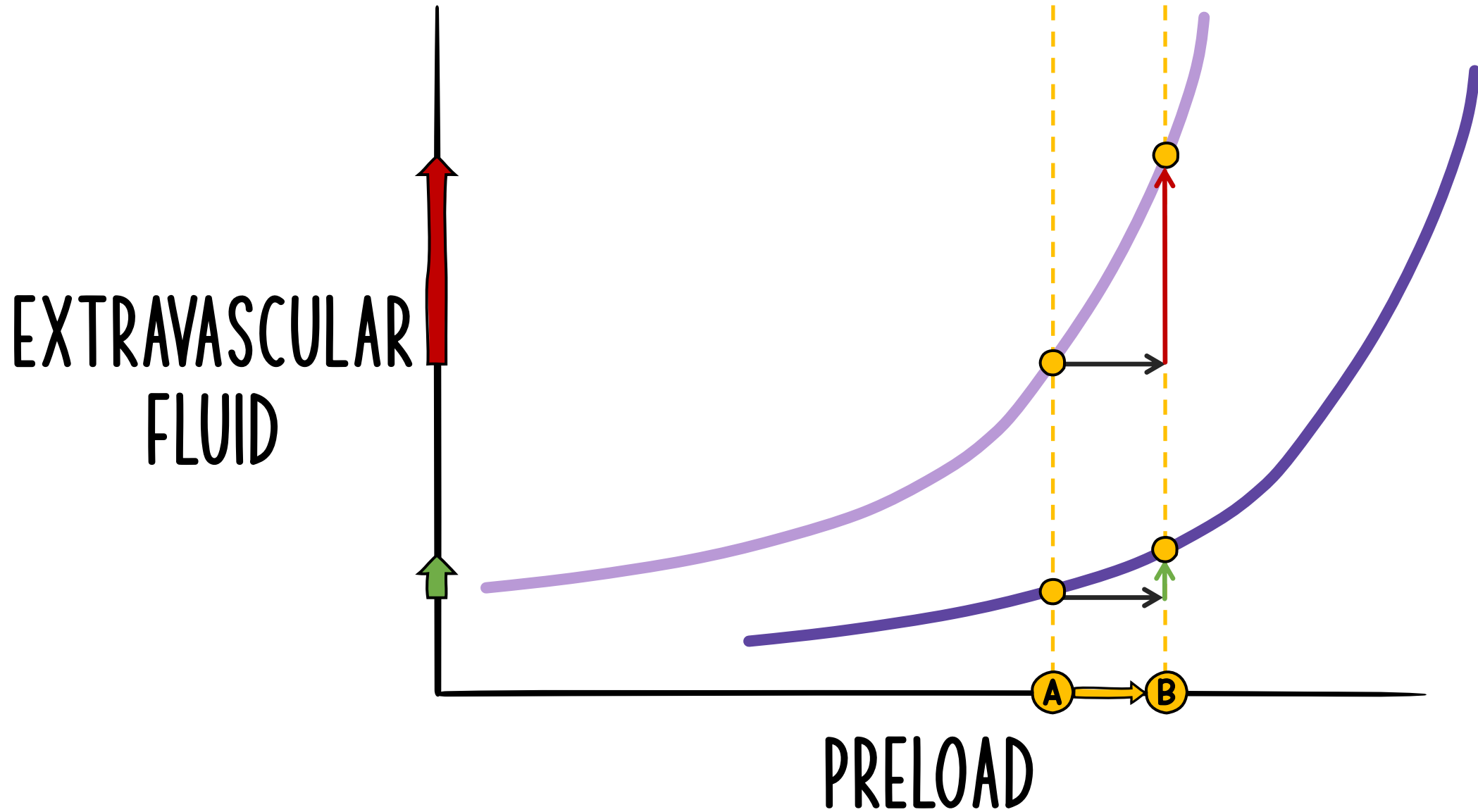




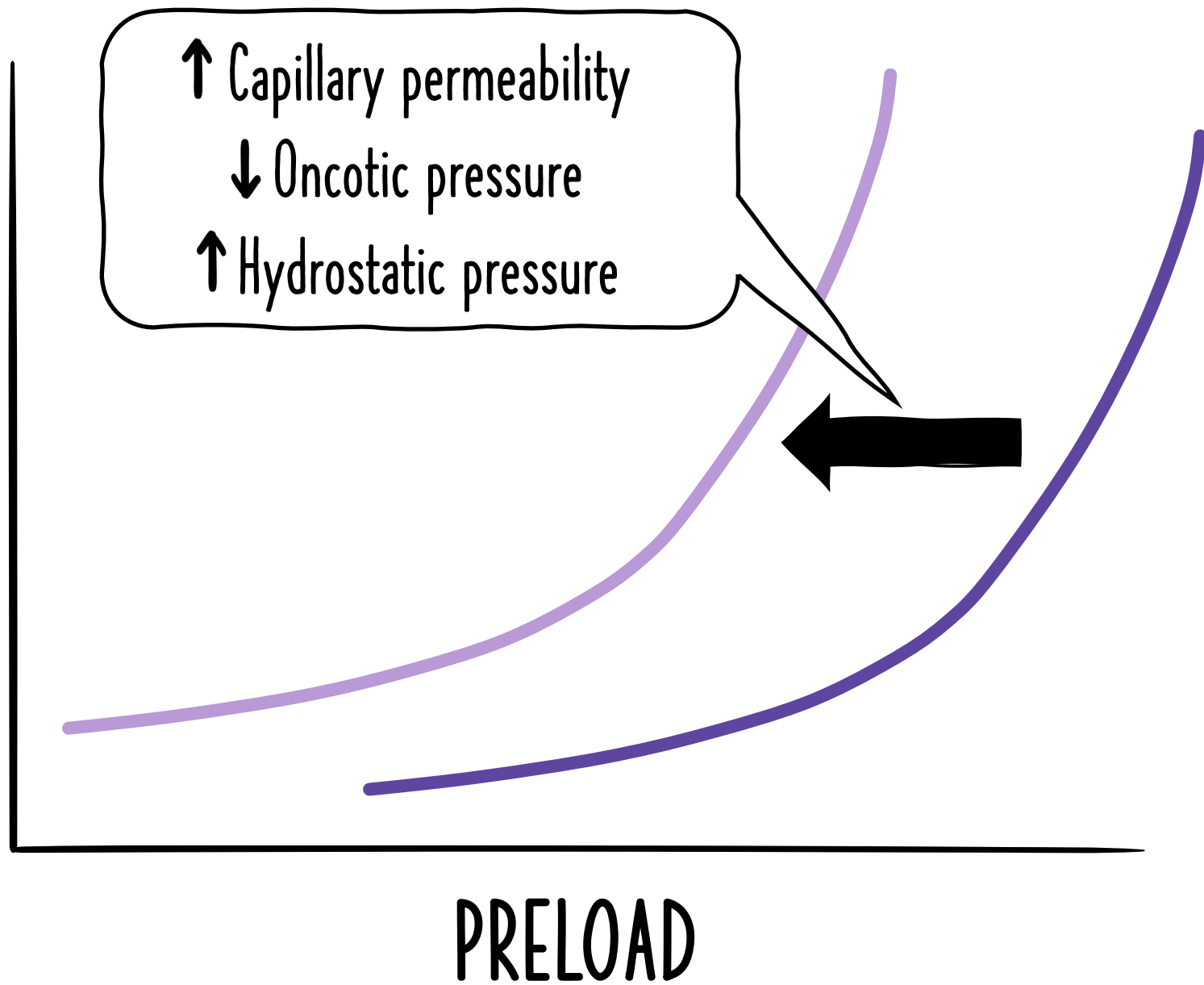
EXTRAVASCULAR
FLUID



PRELOAD

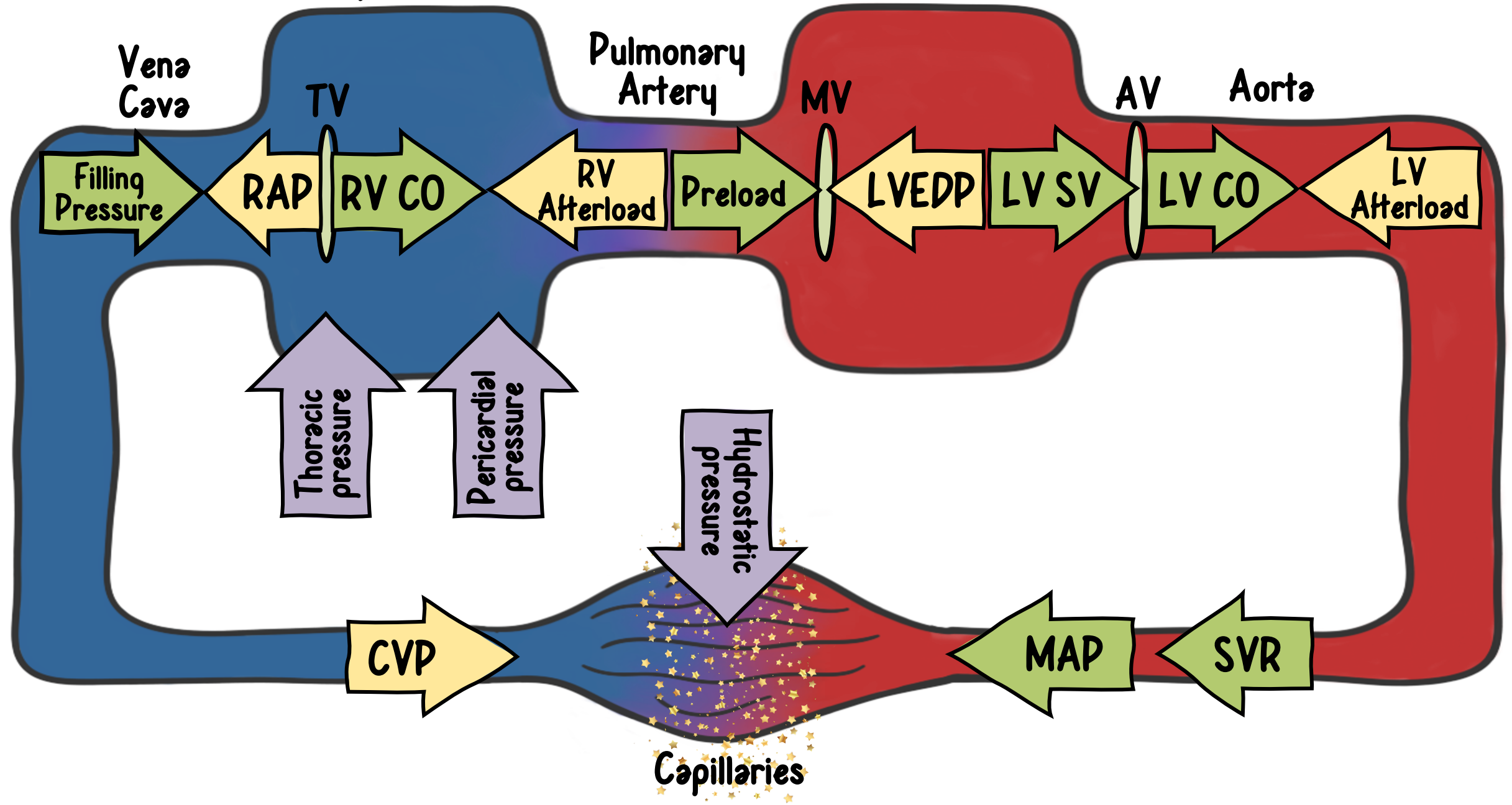


EXTRAVASCULAR
FLUID



Right Heart

Left Heart



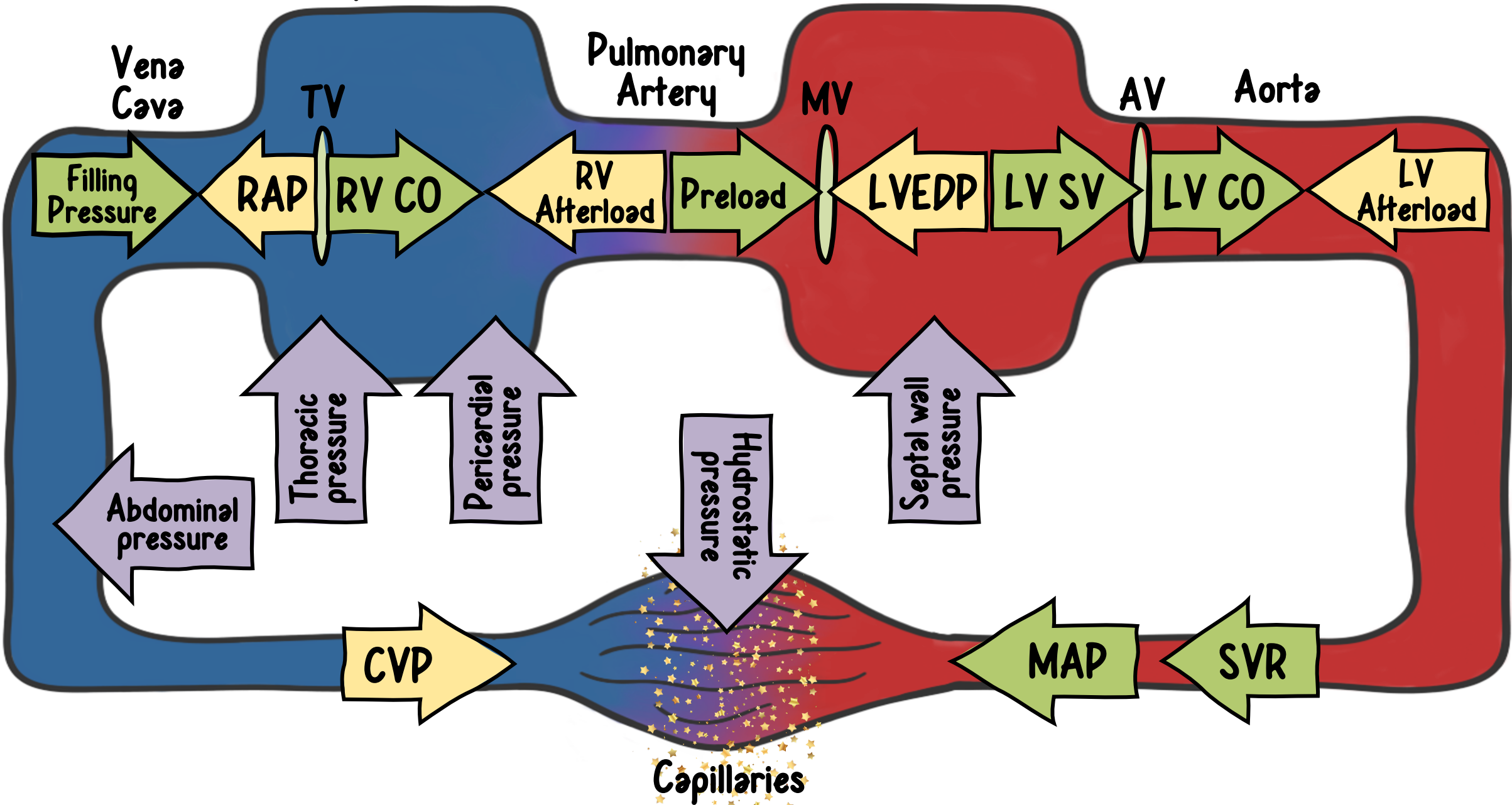


CARDIAC TAMPONADE

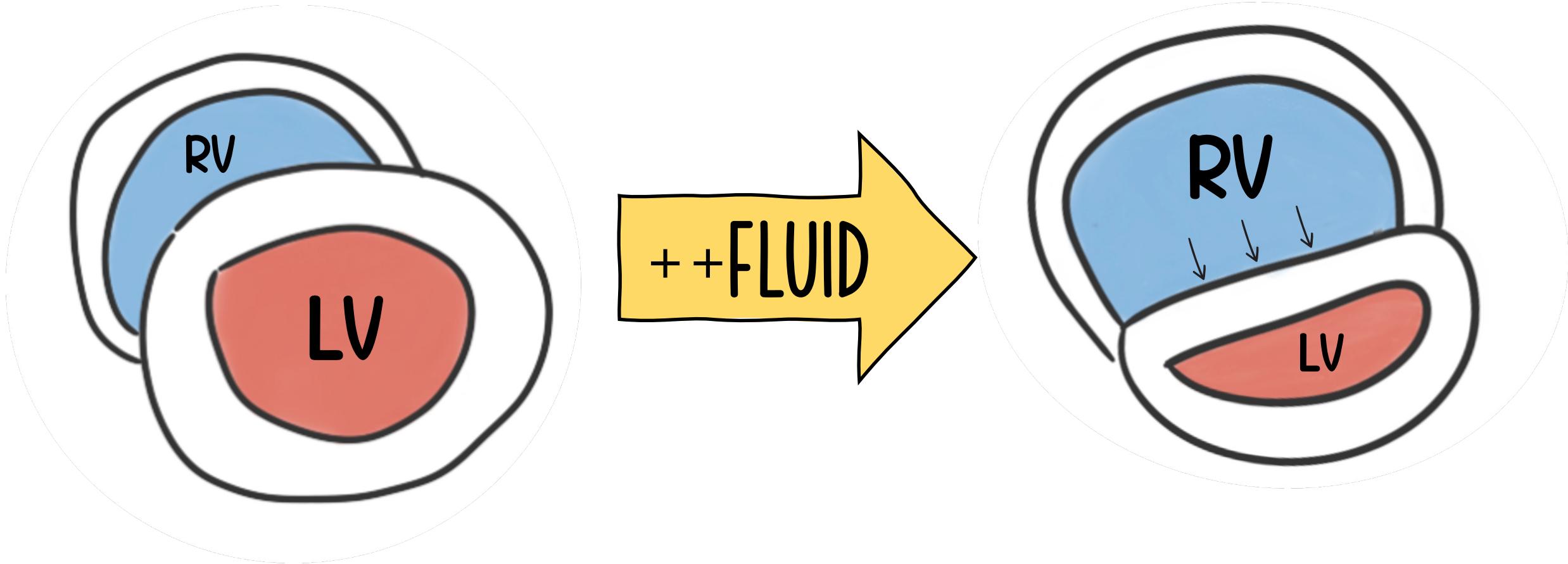
TENSION PNEUMOTHORAX

Right Heart

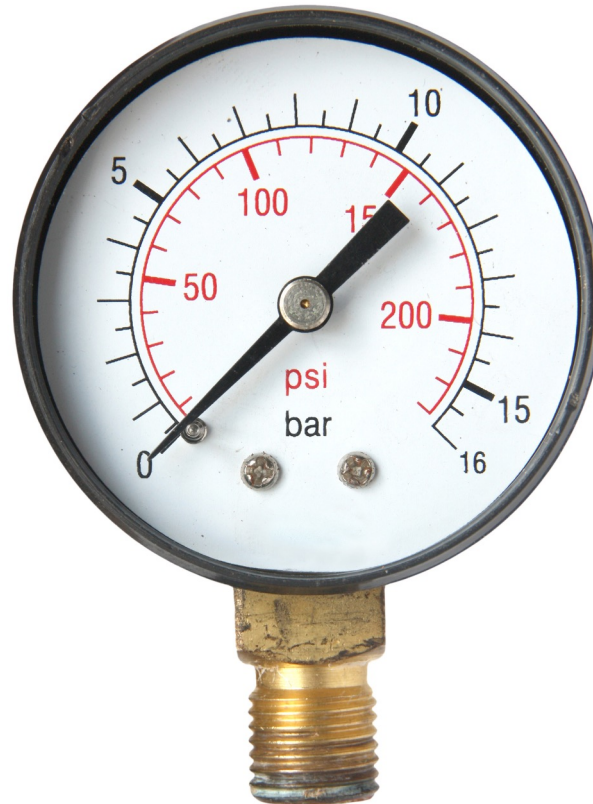
Left Heart



VENTRICULAR INTERDEPENDENCE

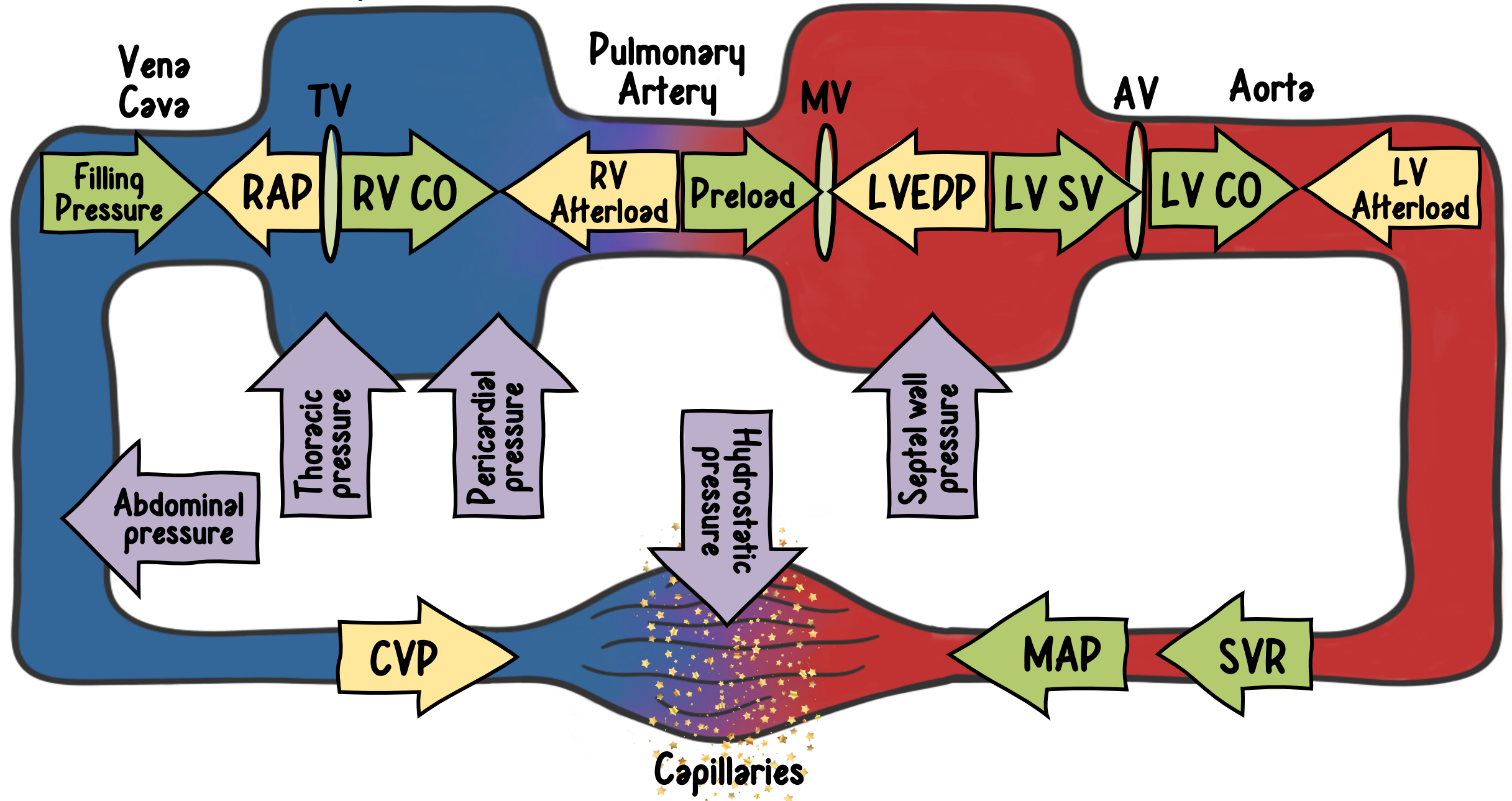


REFRAMING OUR MENTAL MODEL OF SHOCK AROUND PERFUSION PRESSURE



Right Heart

Left Heart



The End

