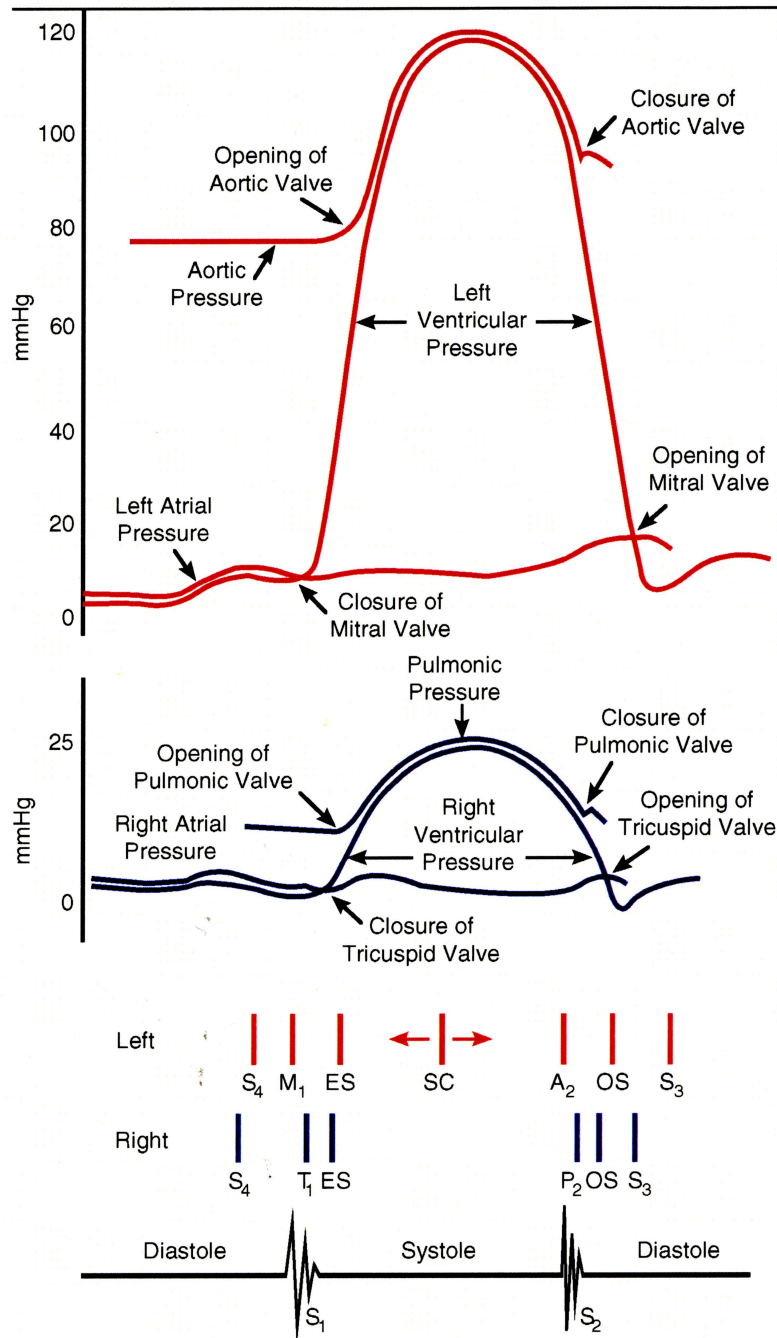


CARDIAC PRESSURE CURVES and HEART SOUNDS



First Sound, S_1 , components:

M_1 – Mitral Closure

T_1 – Tricuspid Closure

Second Sound, S_2 , components:

A_2 – Aortic Closure

P_2 – Pulmonic Closure

Third Sound, S_3

Passive Filling

Fourth Sound, S_4

Atrial Filling

Abnormal Valve Opening

Aortic, E.S.

Pulmonic, E.S.

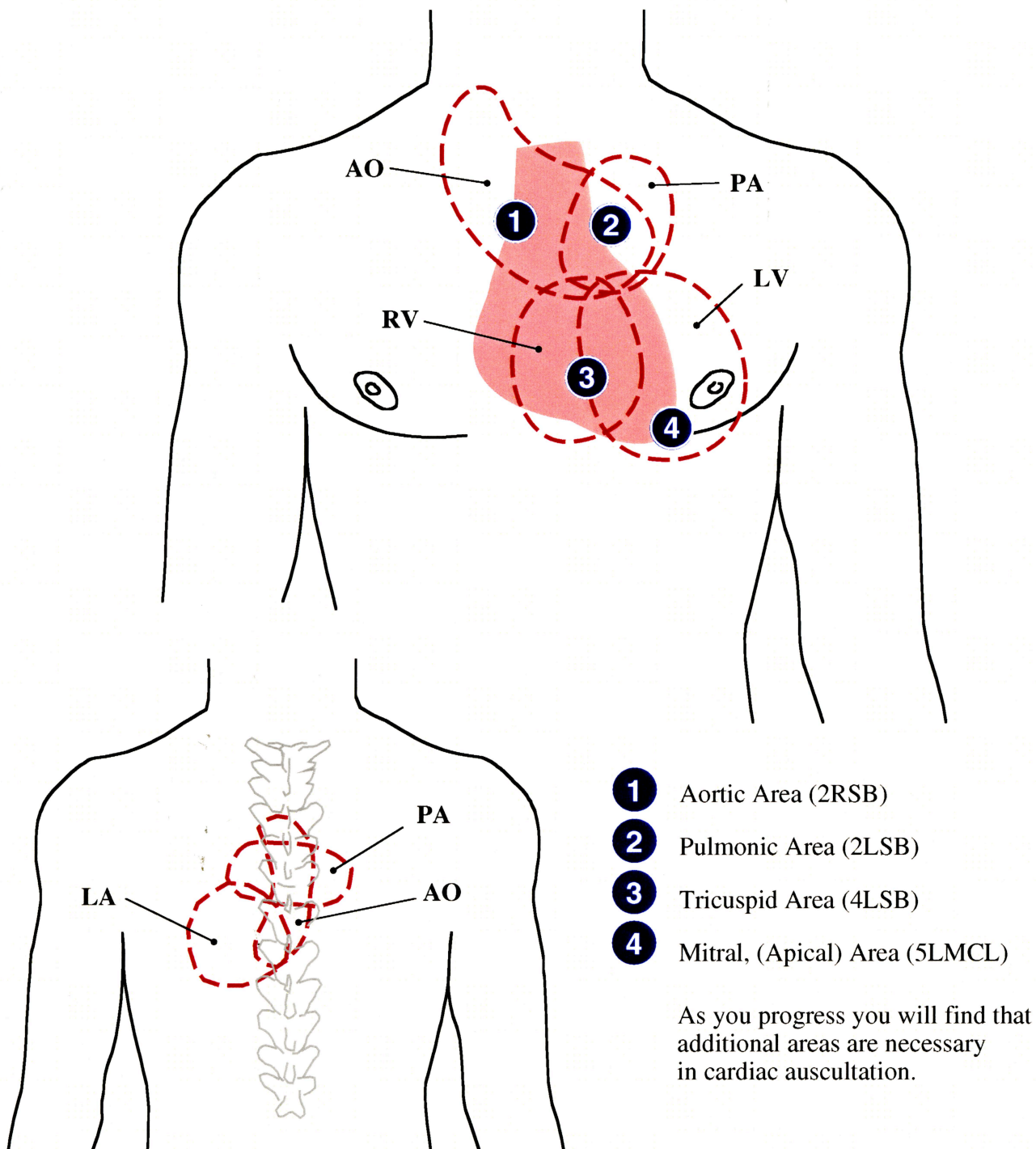
Mitral, O.S.

Tricuspid, O.S.

Mitral Prolapse with

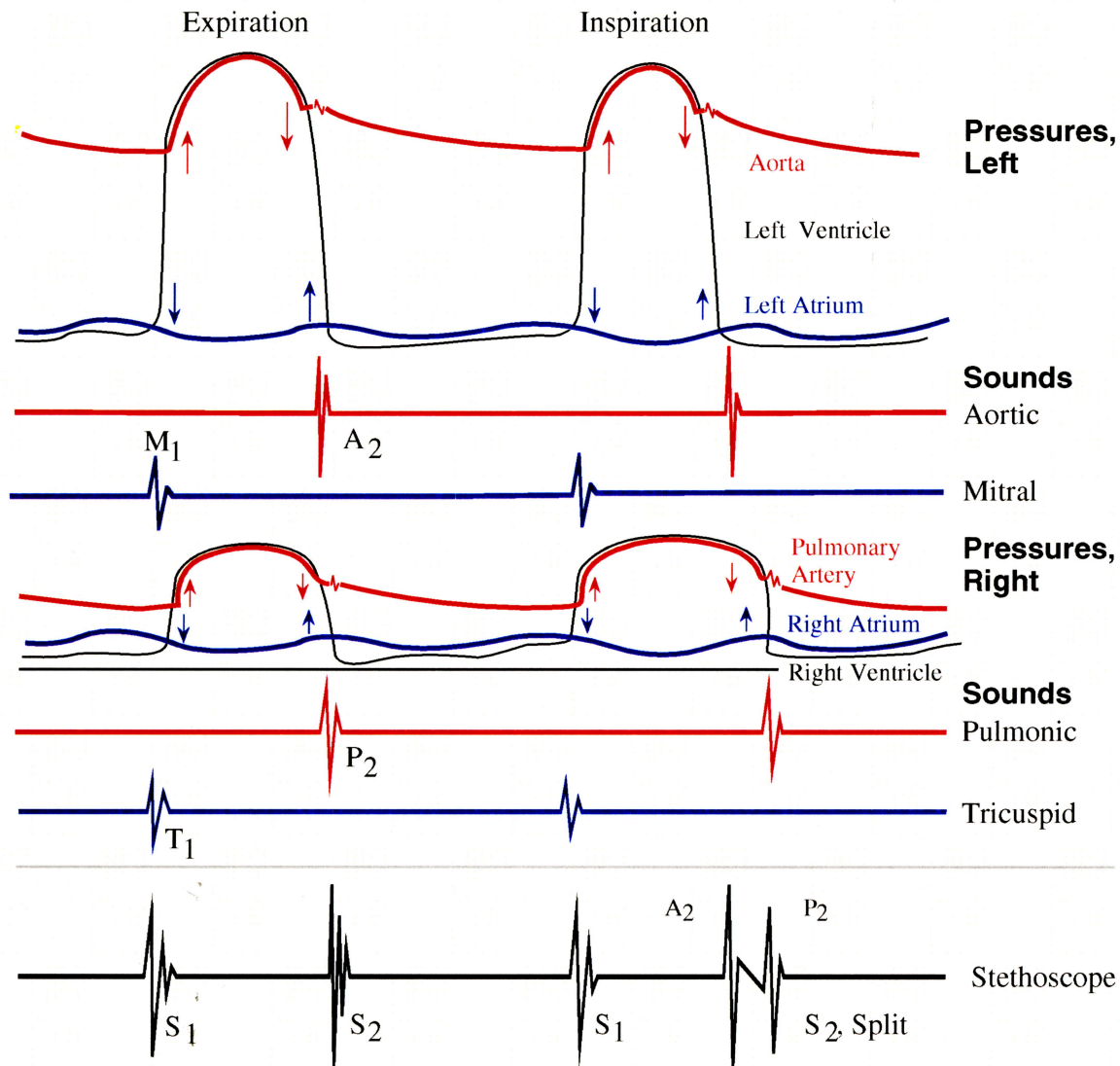
Systolic Click, S.C.

Primary Areas for Cardiac Auscultation



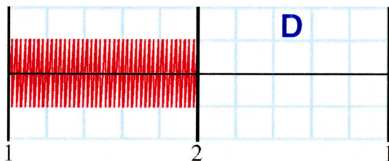
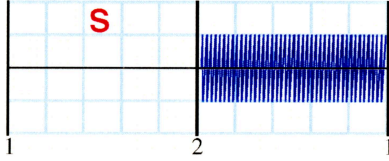
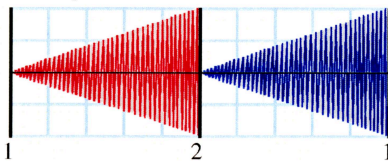
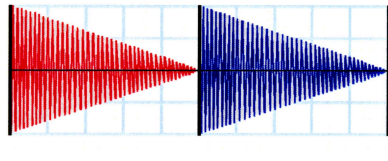
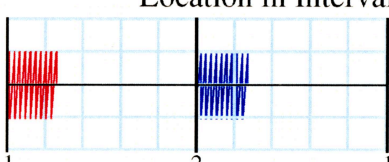
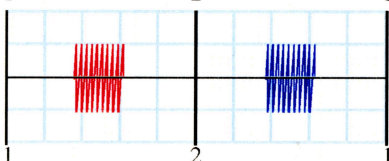
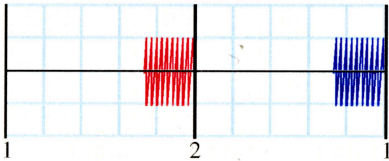
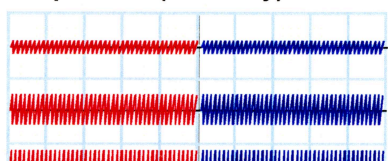
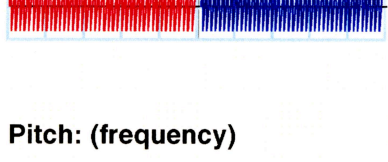
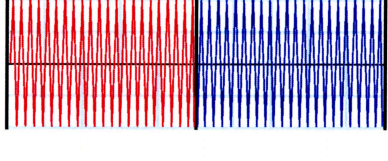
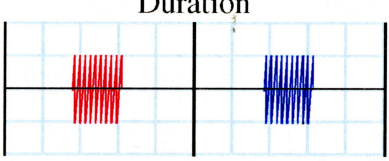
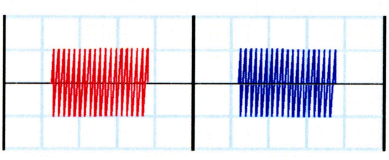
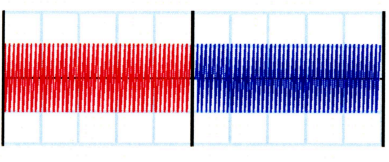
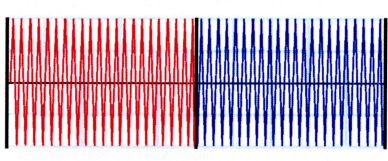
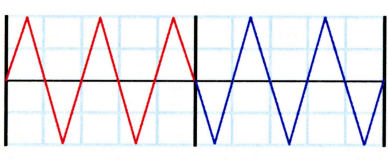
Optimum locations for auscultation of the various anatomic regions are shown in numbered circles. Typical extent of the sounds from various areas are shown by dotted lines. This extent will vary with pathology. Also some sounds and murmurs may “radiate” to other areas such as left axillae in mitral stenosis. Sounds from the aorta (AO), pulmonary artery (PA) and left atrium (LA) may be heard well or even best over the posterior upper thorax as shown.

Fig. 2 Normal Heart Sounds



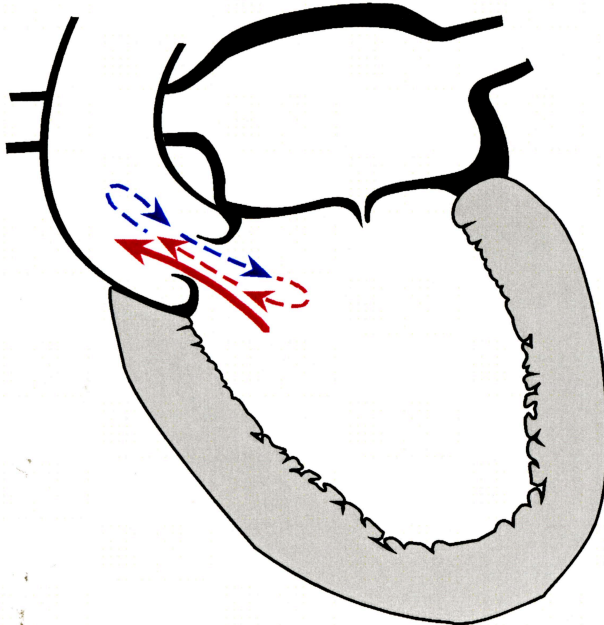
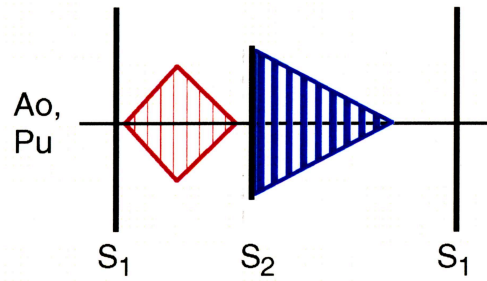
Normal valves open silently, indicated by ↑. Closing times, indicated by ↓, of mitral and tricuspid valves are typically so close that their individual sounds, M₁ and T₁, merge to form S₁. On expiration the same is true for aortic and pulmonic valves and their sounds, A₂ and P₂. With increased negative intrathoracic pressure on inspiration the right heart increases its volume and blood is retained in the lungs reducing left heart volume. Consequently closure of the pulmonic valve is delayed by ejection of the larger volume while aortic valve closure occurs earlier than normal, thus “splitting” the usually merged sounds.




Figure 3.— Diagrammatic and Descriptive Features of Heart Sounds/Murmurs

Diagram	Description	Diagram	Description
Timing: Interval  		Shape: (Independent of duration)  	
Location in Interval   		Amplitude: (intensity)   	
Duration   		Pitch: (frequency)  	
Quality: NA Location, variation with respiration: NA		Quality: NA Location, variation with respiration: NA	
Description Systolic Diastolic Early Mid Late Short ("brief") Long Pan or Holo (entire interval)		Description Crescendo (rising) Decrescendo Crescendo, Decrescendo "Diamond Shaped, triangular" Grade: 1 – barely audible 2 – audible 3 – moderately loud 4 – loud 5 – very loud 6 – heard without stethoscope, may be palpable High Low "Blowing," "soft," "quiet," "cooing," "machinery," "rumble," etc. Describe where loudest, radiation	

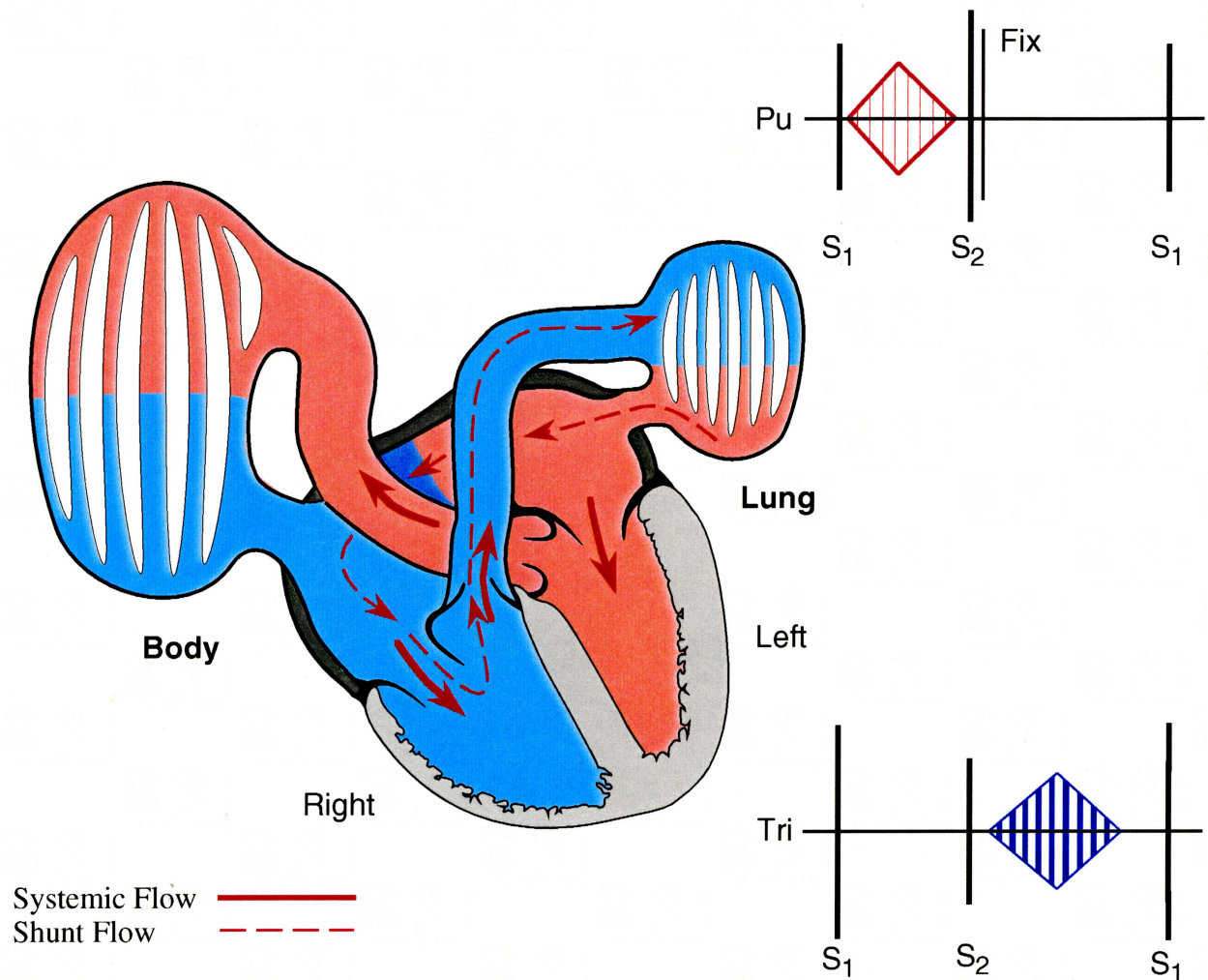
Note: "Pre-" and "Post" are closely associated with another event; e.g., pre systolic

Flow Murmur from Regurgitant Aortic/Pulmonic Valve



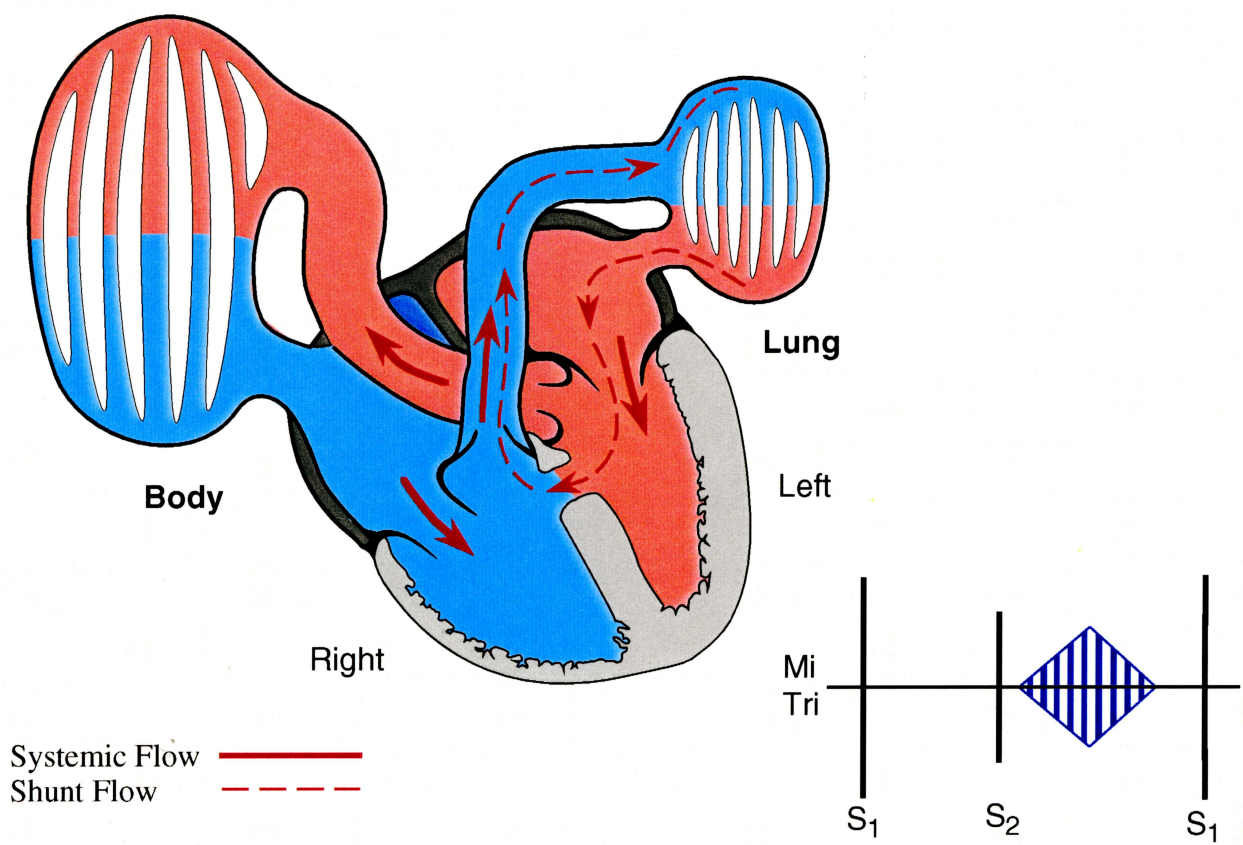
Regurgitant Systolic Flow 
Regurgitant Diastolic Flow 
Systemic Systolic Flow 

Flow Murmurs from Shunt (ASD)



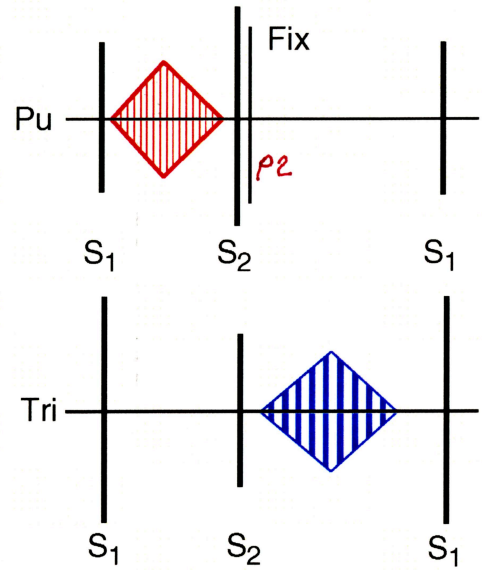
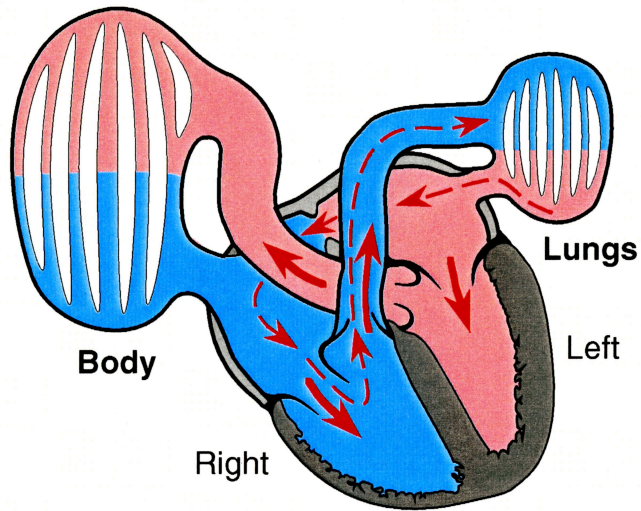
When blood is shunted through the heart by a defect, this flow is added to system flow and may cause turbulence and murmurs from otherwise normal valves in the shunt pathway. In this case flow through an atrial septal defect does not reach murmur threshold, but increased flow through mitral and pulmonic valves produces murmurs.

Flow Murmur from Shunt (VSD)

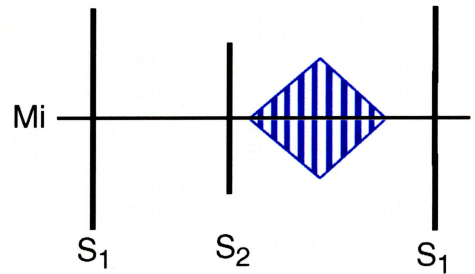
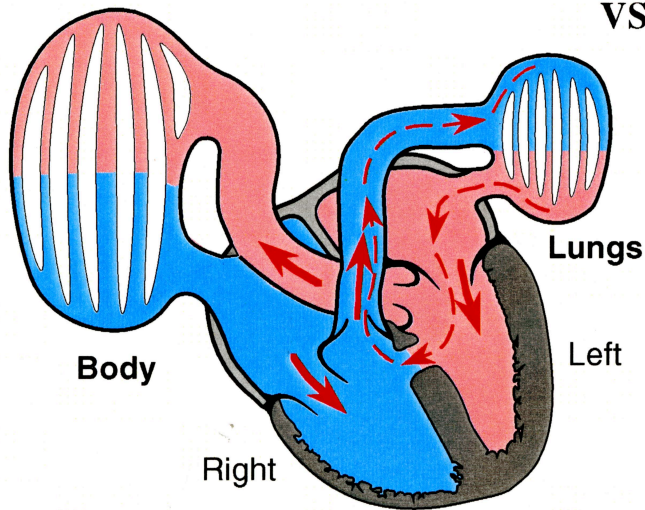


Secondary Flow Murmurs from Shunts

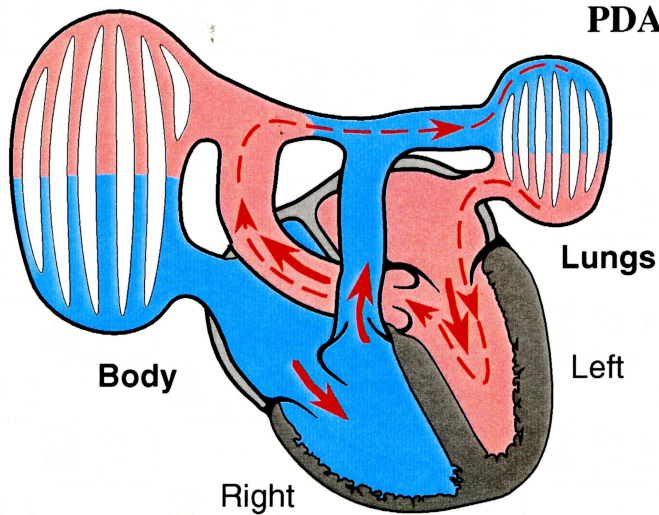
ASD





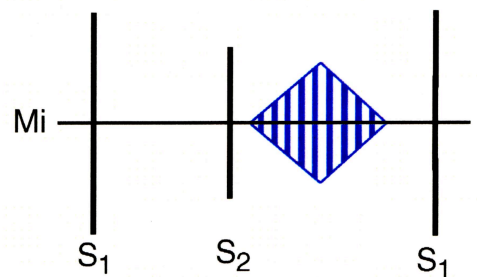
VSD



PDA



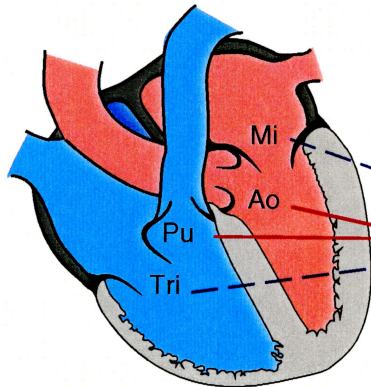
Systemic Flow 
Shunt Flow 



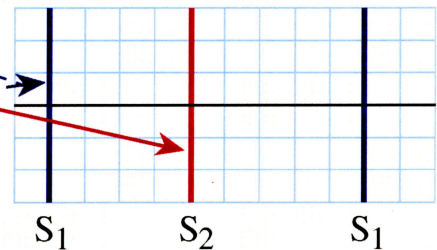
Sources of Heart Sounds

First, S₁, and Second, S₂, Heart Sounds

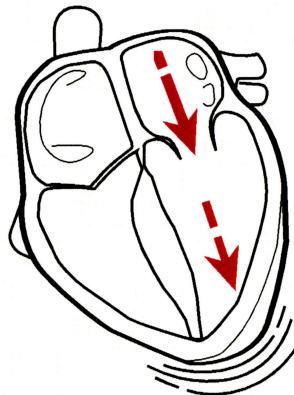
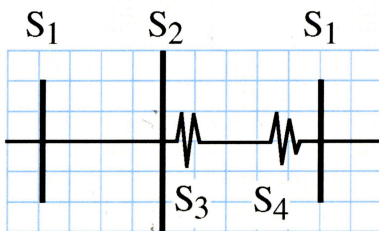
Arrest of reverse blood flow by valve closure:



Mitral and Tricuspid – S₁
Aortic and Pulmonic – S₂
Sounds may be
normal or **abnormal**



S₃, S₄ Pulmonic Knock



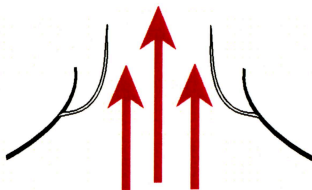
Diastolic inflow of blood exceeds capacity of ventricle to accommodate it, and ventricle is “shoved” longitudinally.

S₃ produced by passive filling

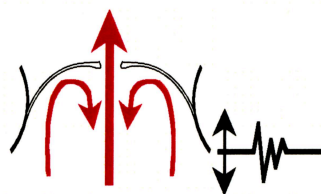
S₄ produced by atrial filling

S₃ may be normal

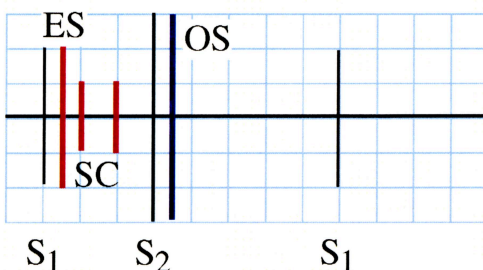
Ejection Sounds, ES, Opening Snaps, OS, and Systolic Clicks, SC



Normal



Stenotic



Valve begins to open normally and is suddenly arrested by stenosis. This “jerks” surrounding tissue – producing “ejection sounds” from aortic/pulmonic valves and “opening snaps” from mitral/ tricuspid valves. “Systolic clicks” are produced by a similar mechanism when a cusp of mitral or pulmonic valve “pops” open in systole (may be multiple).