

Electrocardiography

Department of Physiology

Specific learning objectives

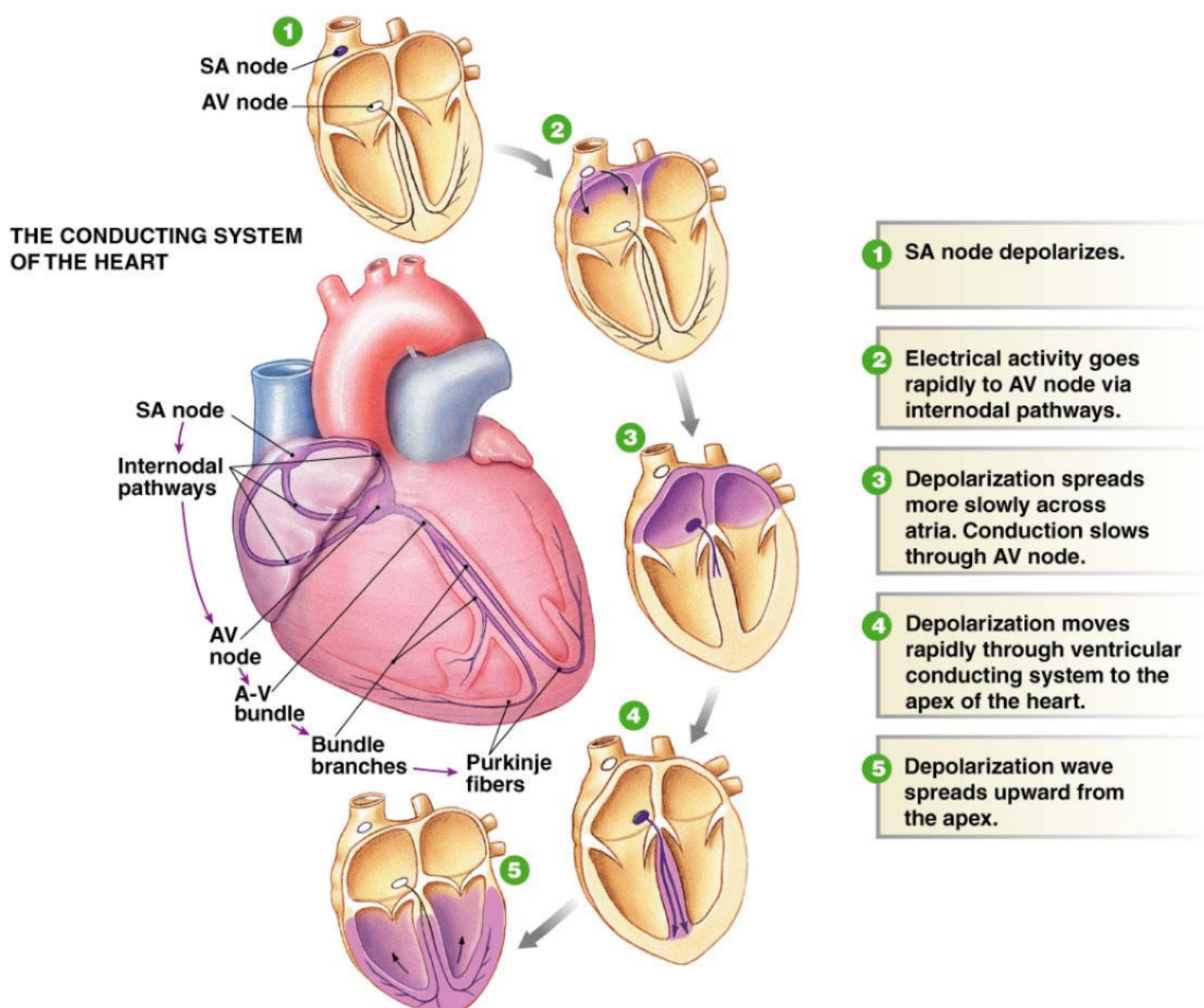
- Introduction
- History
- Normal ECG
- Procedure
- Limb Leads

ECG, EKG

It is the procedure of recording the electrical activity of the heart. The electrode combination records the difference of potential difference at two sites on the body. The potential differences are produced due to the electrical activity of the heart.

Electrocardiograph is the machine
Electrocardiogram is the record

The characteristic shape and timing of the ECG waves are due to the spread of wave of depolarization and repolarization associated with each heart beat.





The Nobel Prize in Physiology or Medicine 1924

"for his discovery of the mechanism of the electrocardiogram"

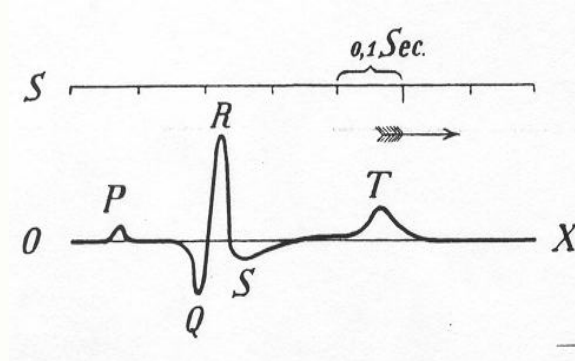


Willem Einthoven

the Netherlands

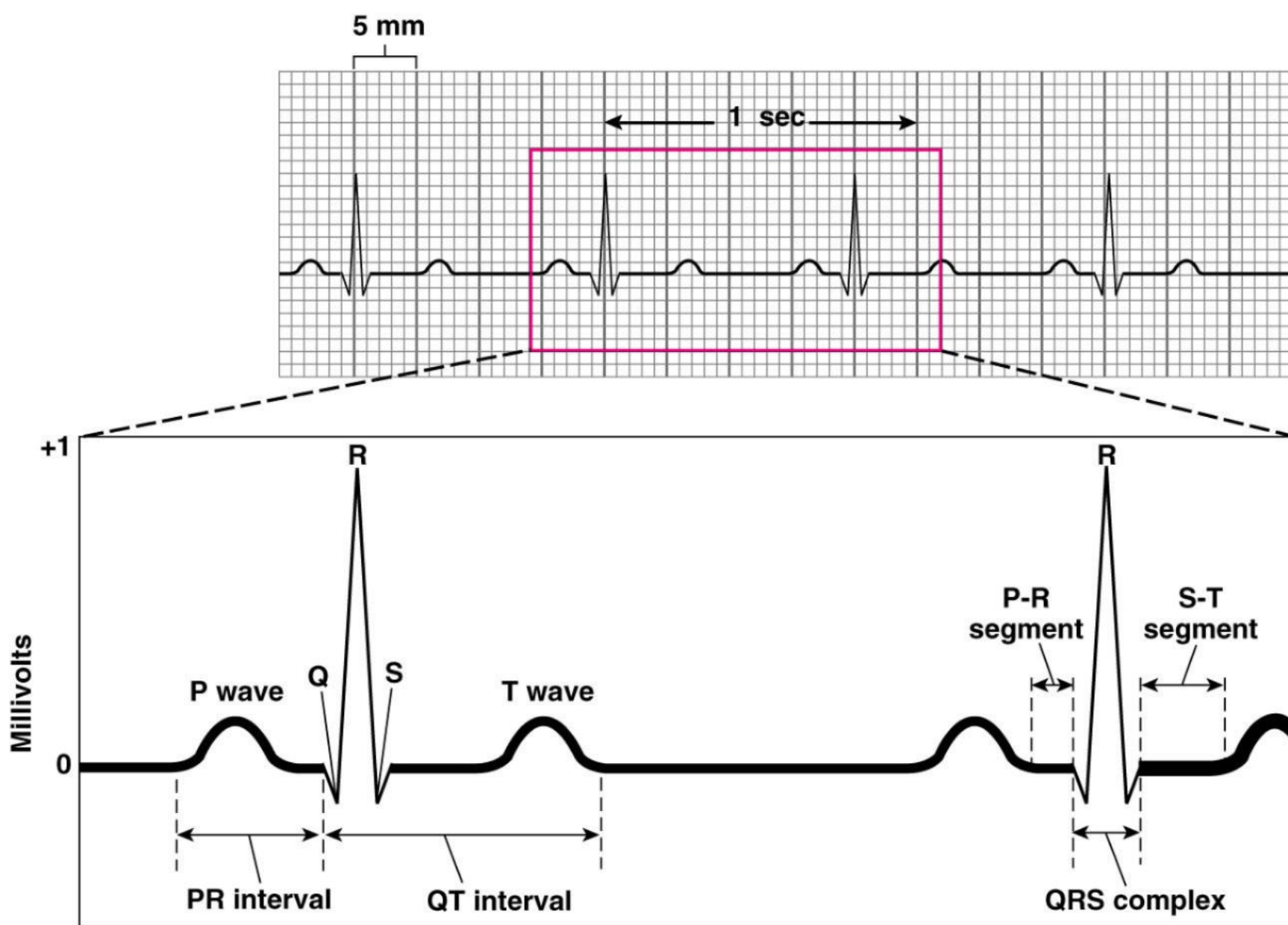
Leiden University
Leiden, the Netherlands

b.1860
(in Semarang, Java, then Dutch East Indies)
d.1927



The ECG is not only the oldest but, in fact, over 100 years after its introduction, continues as the most commonly used cardiovascular laboratory procedure.

What does the ECG look like?



ECG PAPER

.1 MV

VOLTAGE

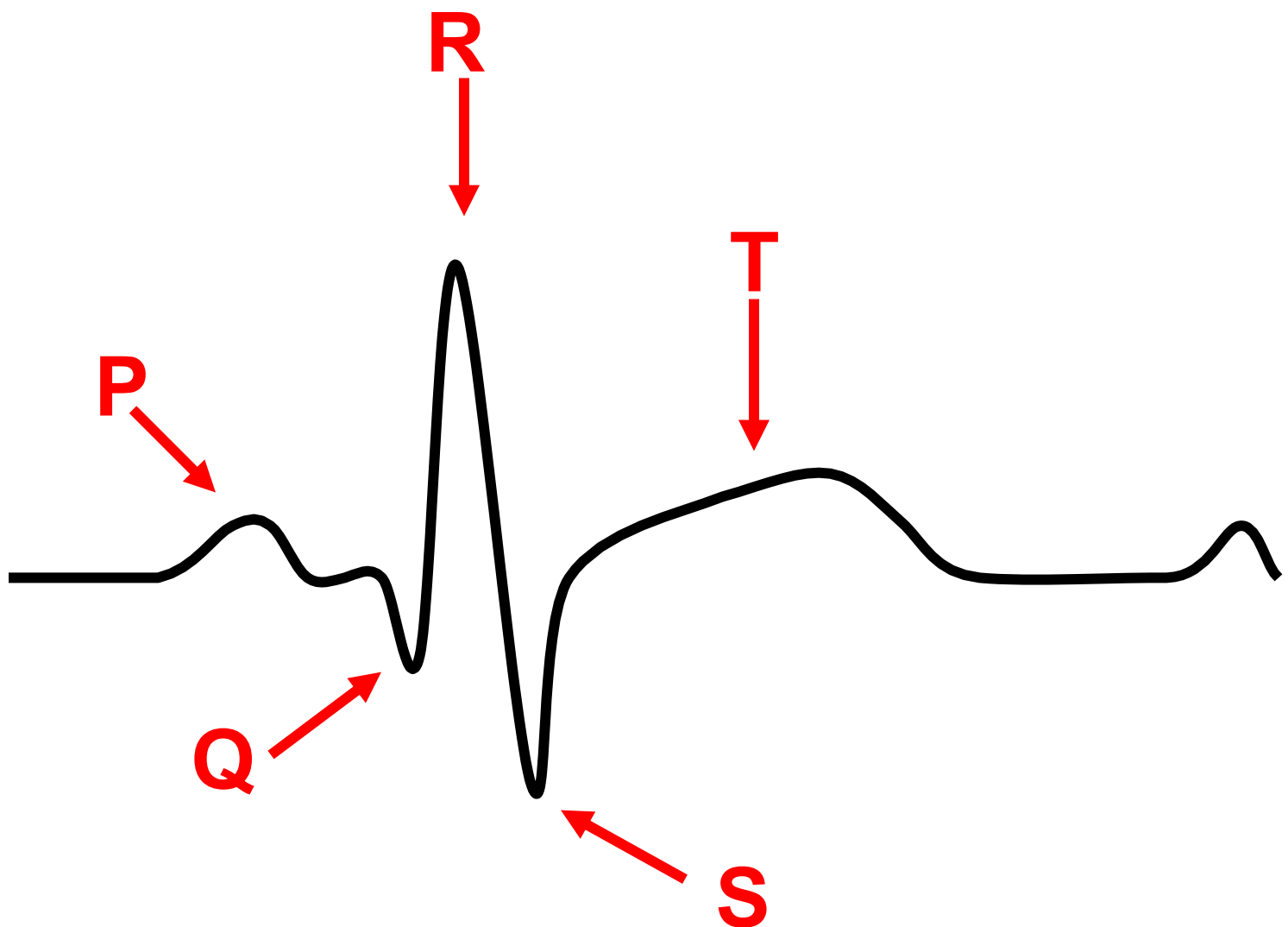
.5 MV

.04 SEC.

.20 SEC.

TIME

Waves



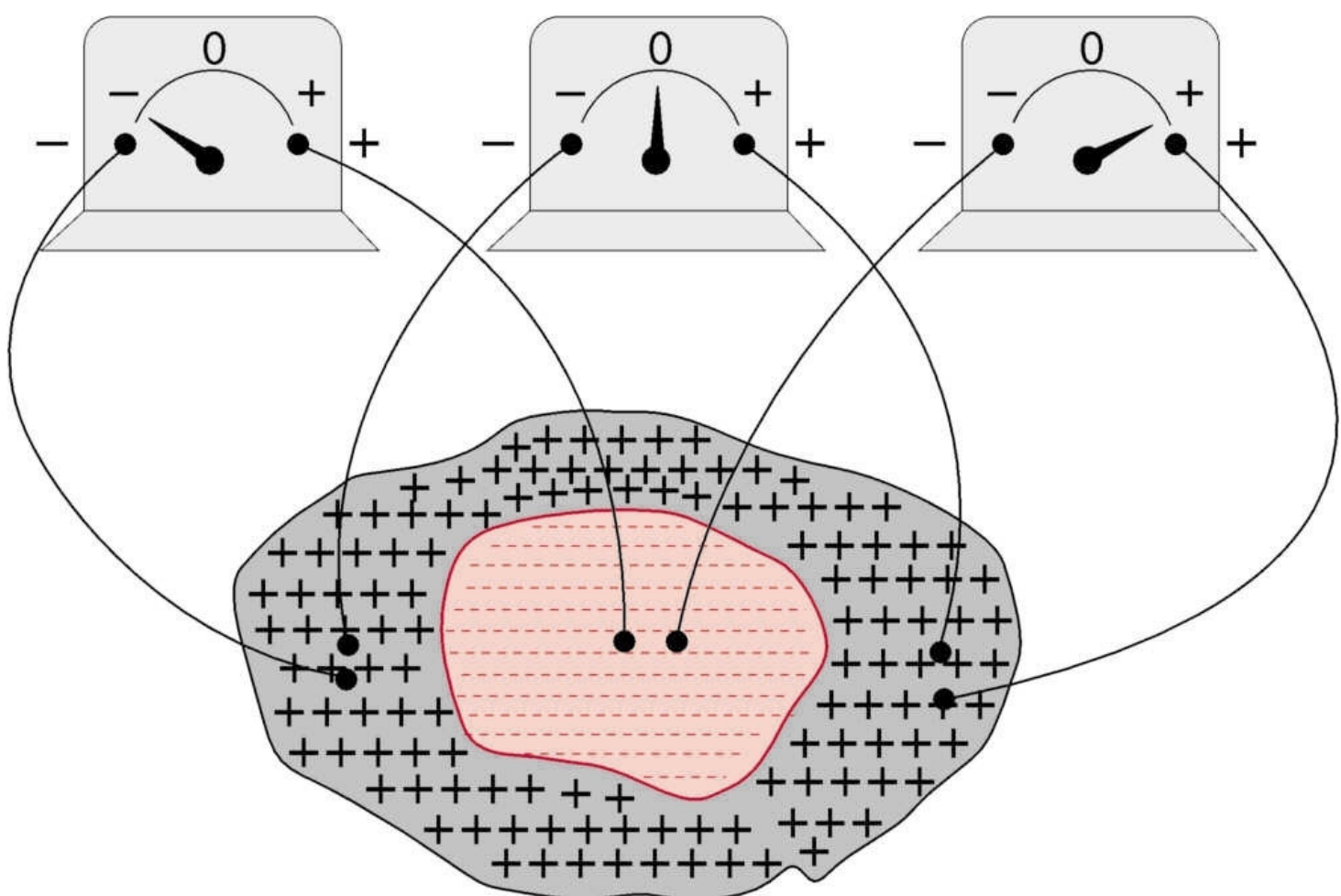
Electrocardiogram waves

- P-wave – depolarization of atria
 - Atria begin contracting about 25msec after the start of the p-wave
- QRS-complex – ventricular depolarization
 - Ventricles begin contracting shortly after the peak of the R wave
- T-wave – ventricular repolarization

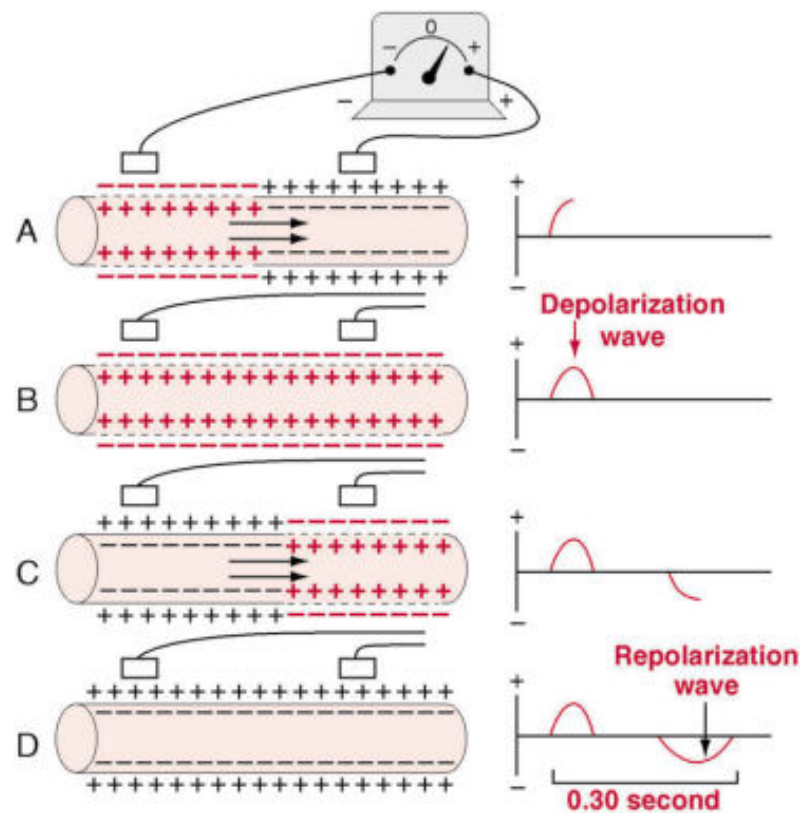
Electrocardiogram intervals/segments

- Segments – extend from the end of one wave to the start of another
- P-R interval: start of atrial depolarization to start of QRS
- Q-T interval: time required for ventricles to undergo a single cycle of depolarization and repolarization; measured from end of P-R to end of T

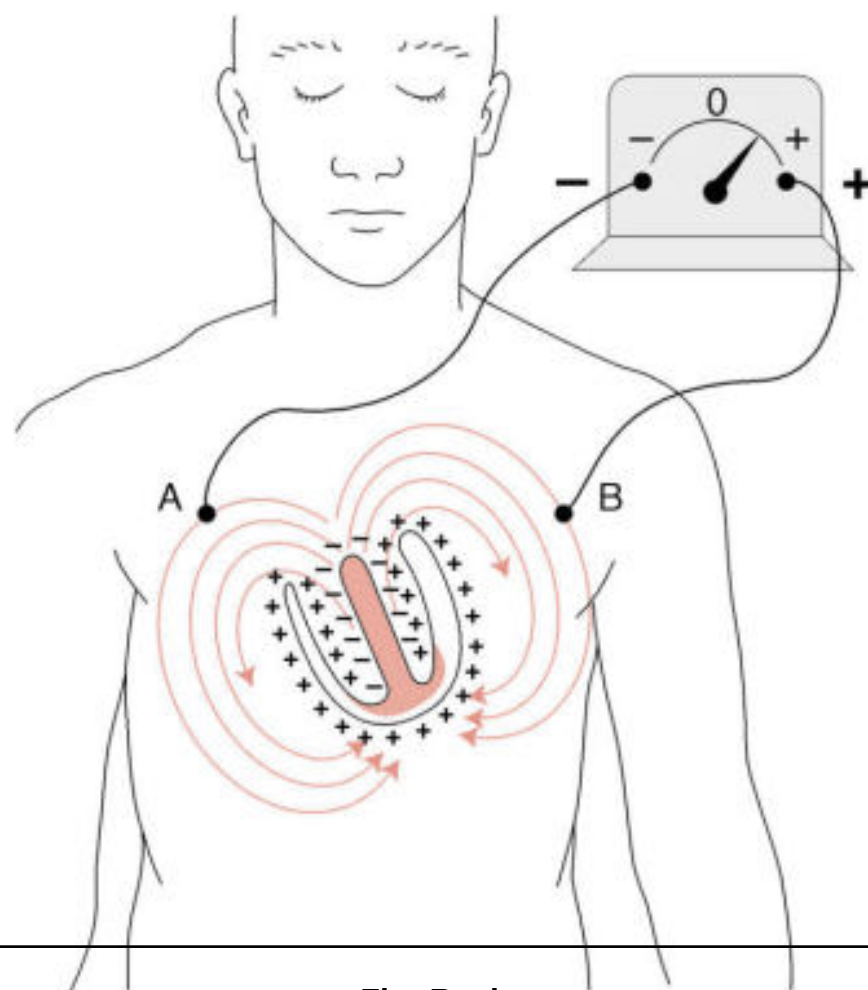
Instantaneous potentials developed on the surface of a cardiac muscle mass



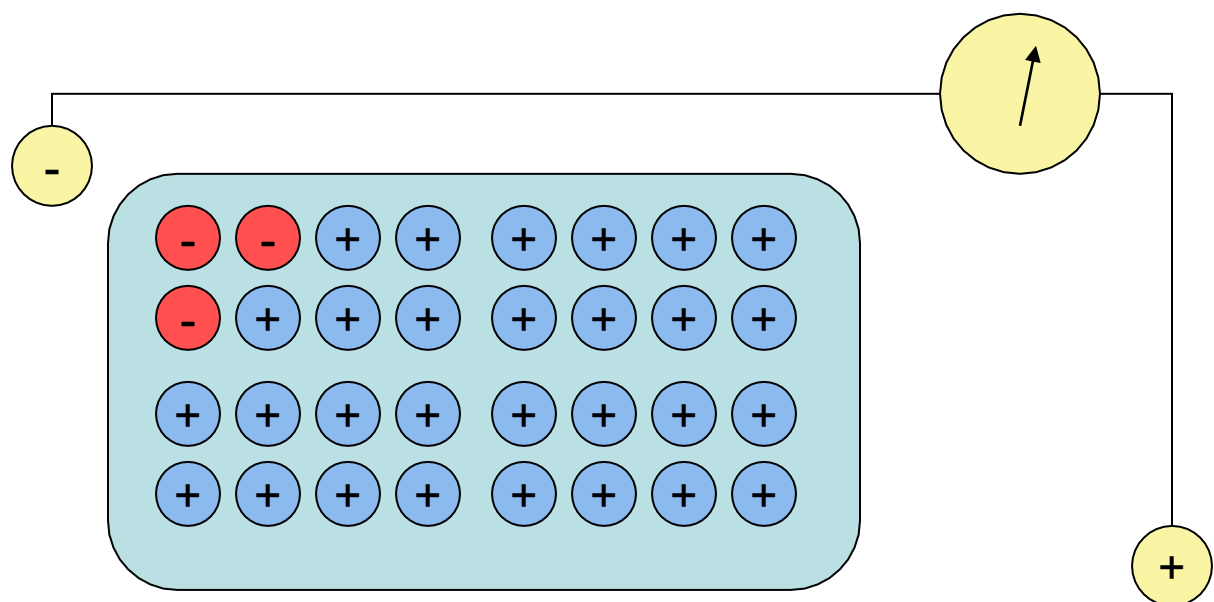
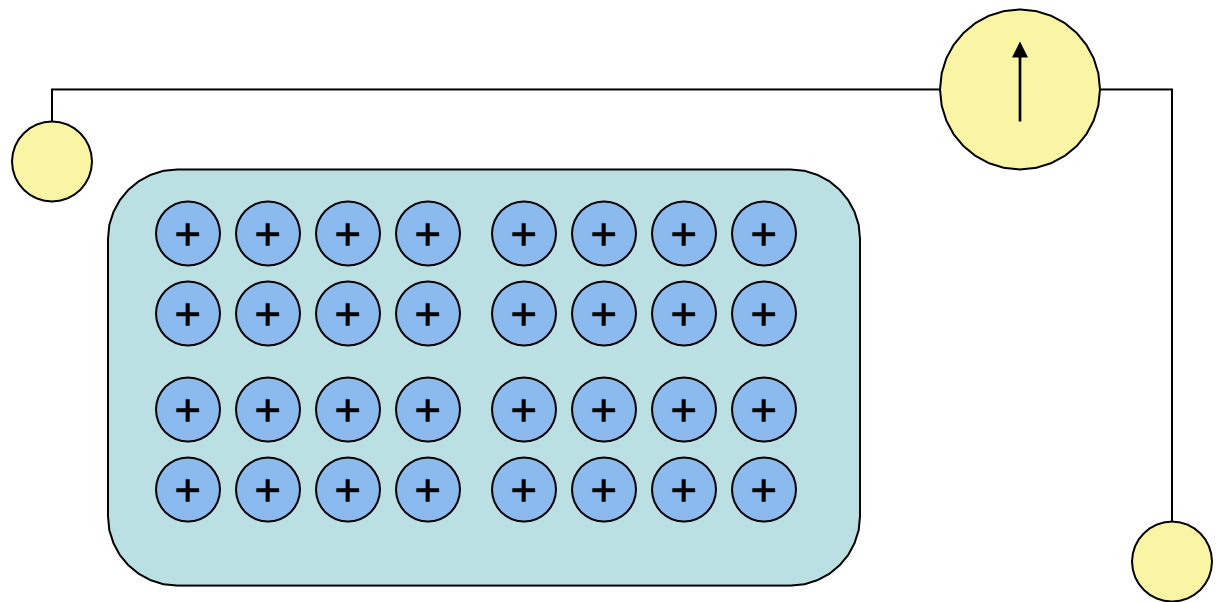
Recording depolarization and repolarization waves



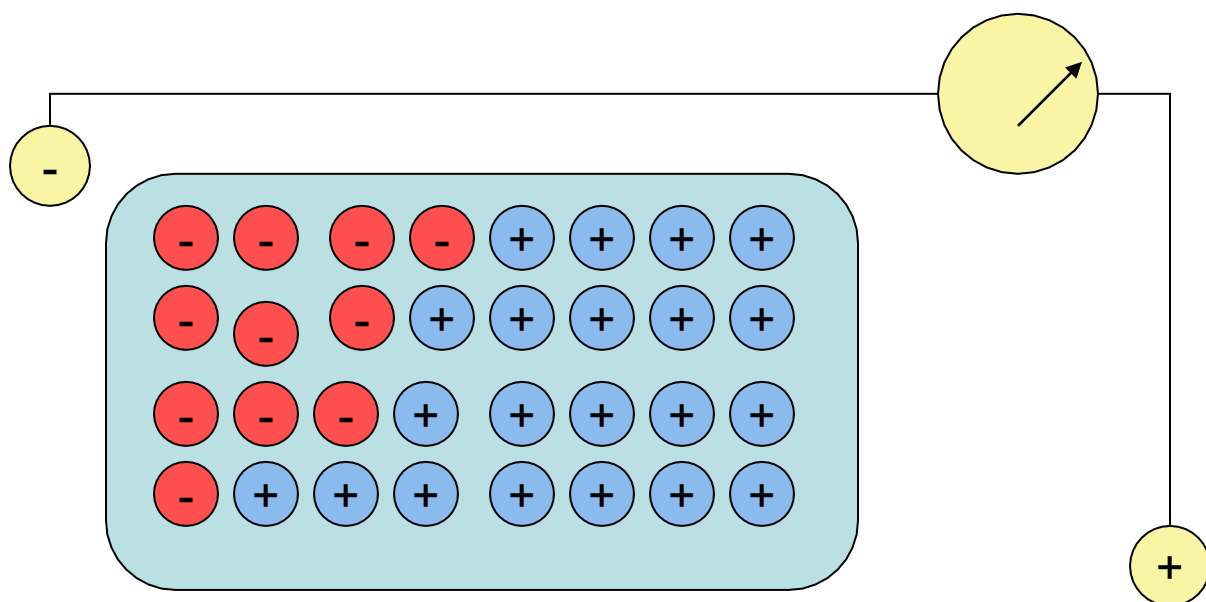
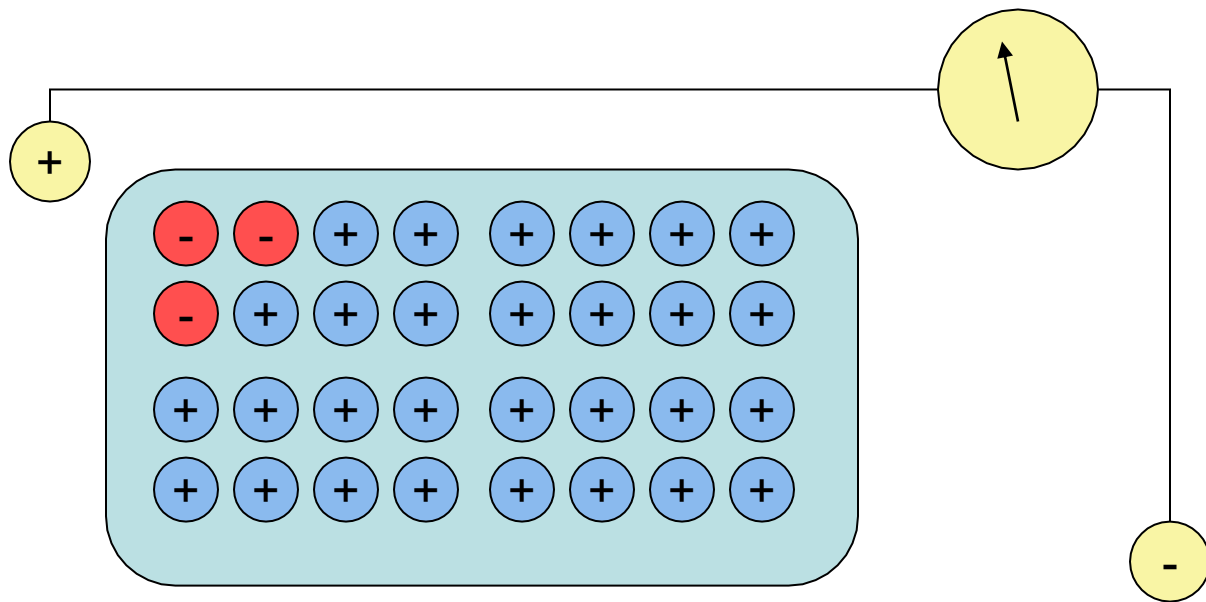
Flow of current in the chest around partially depolarized ventricles

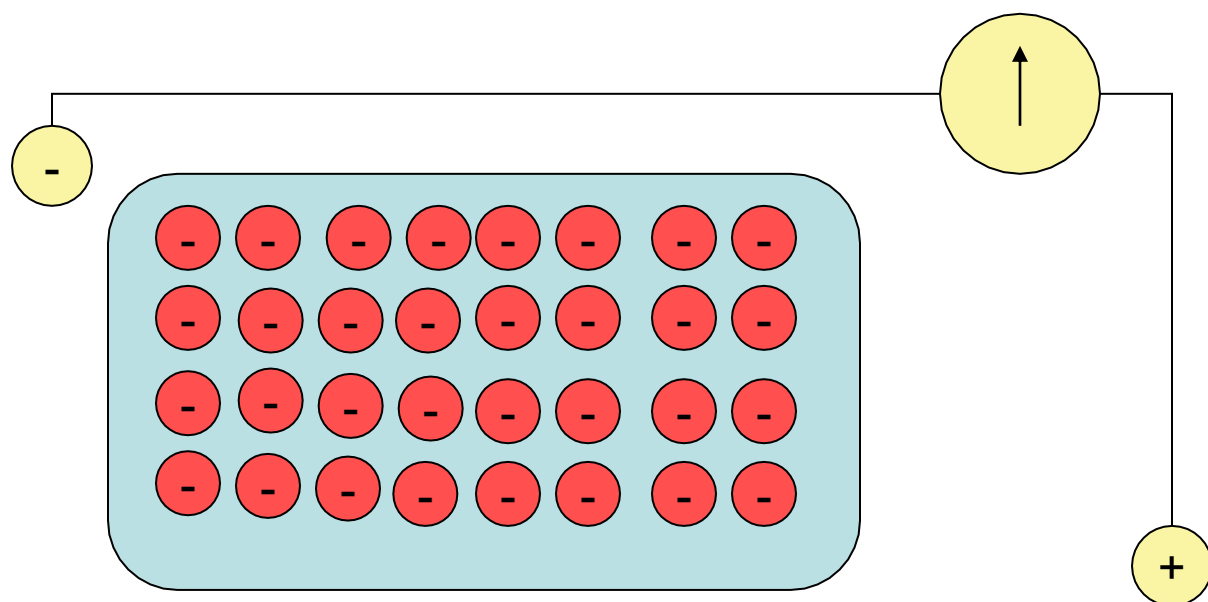
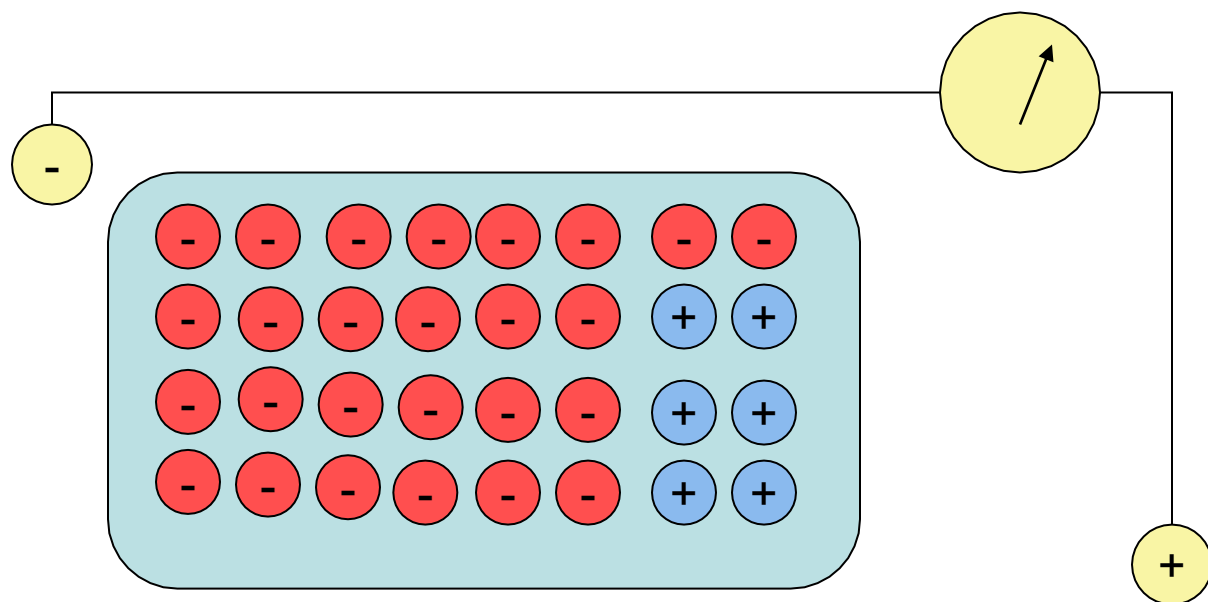


Generation of dipole over heart



If the polarity is reversed?





Remember

The representation of the electrical activity of the heart is critically dependent on the **position of the electrodes**. The same electrical activity will look different on different electrode combinations

A combination of electrodes for recording is called a **LEAD**

Leads that are routinely used for standard 12 lead ECG

Standard Limb Leads

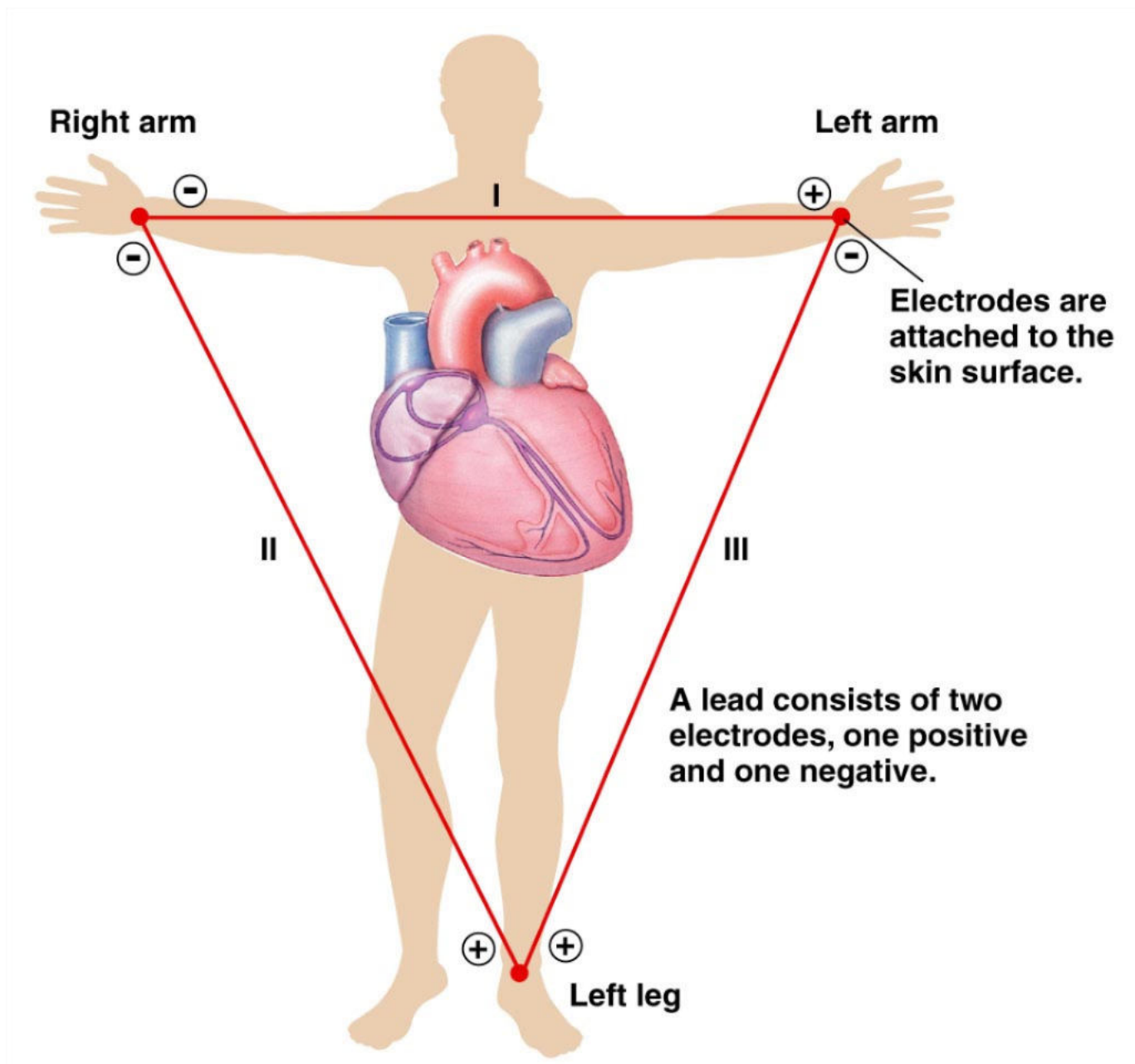
Wilhem Einthoven

Augmented Limb Leads

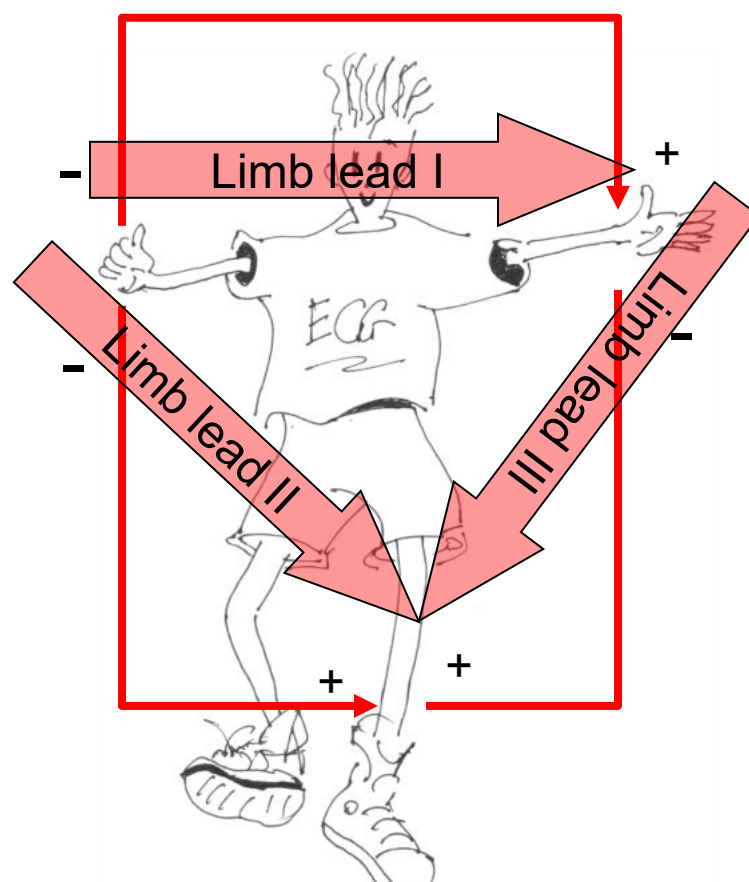
E Goldberger

Precordial Leads

Frank Wison

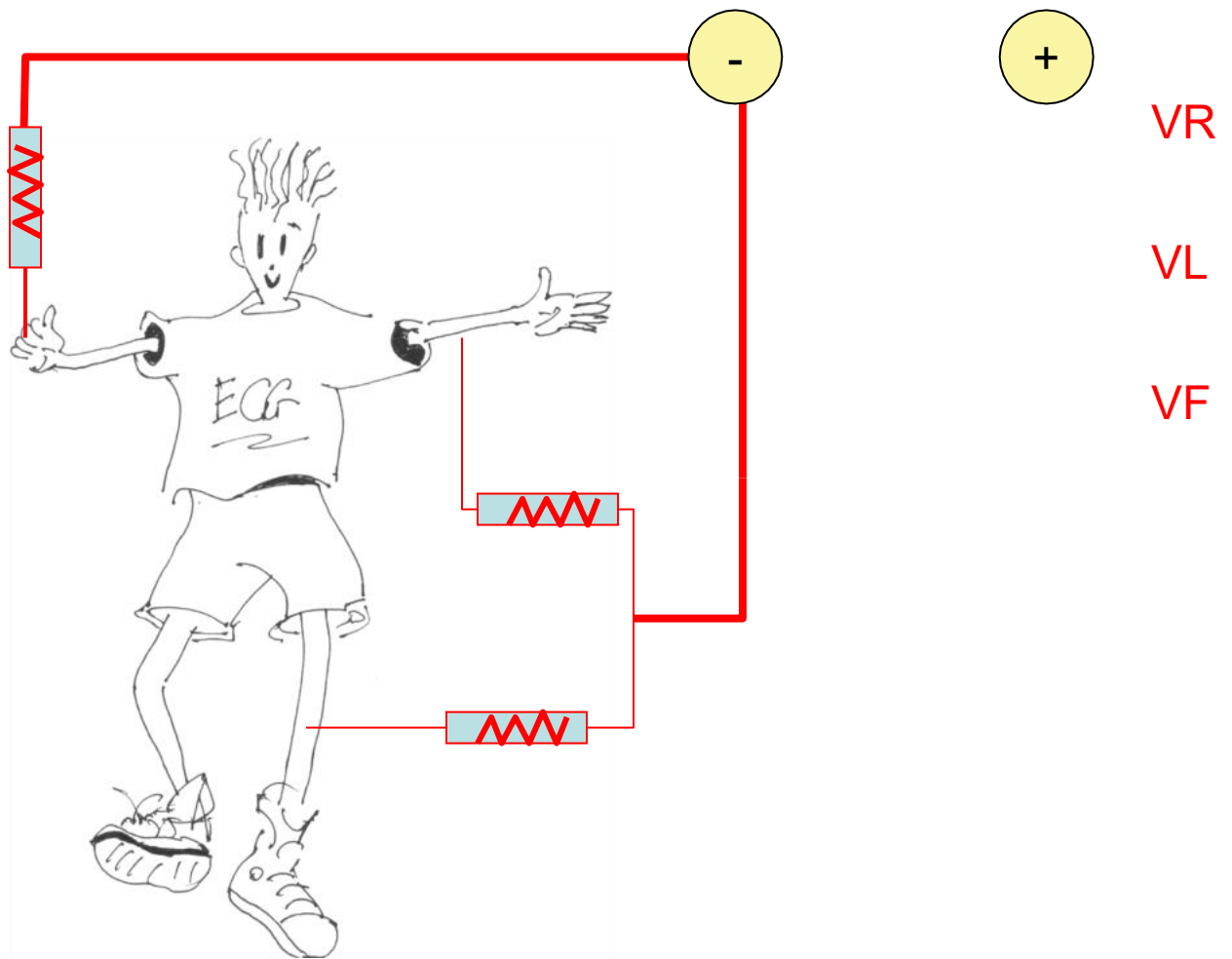


Standard Limb Leads



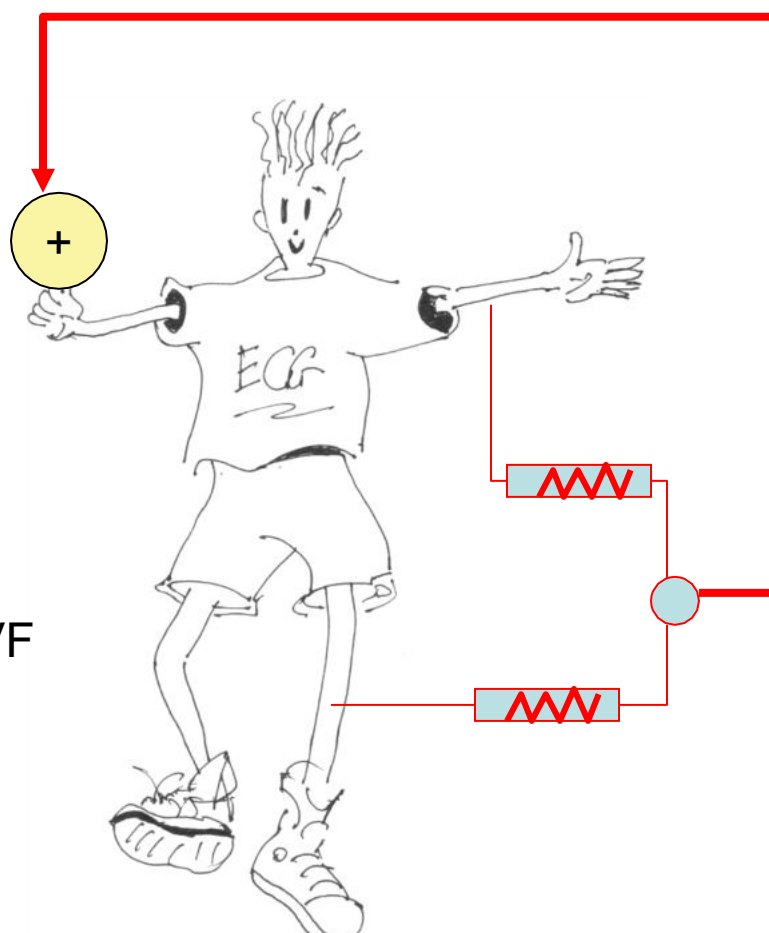
Einthoven's triangle
Einthoven's Law

Unipolar Limb Leads



Augmented Limb Leads

aVR



Similarly, aVL and aVF

Augmented lead is 1.5 X unipolar lead

$$aVL = VL - (VR + VF) / 2$$

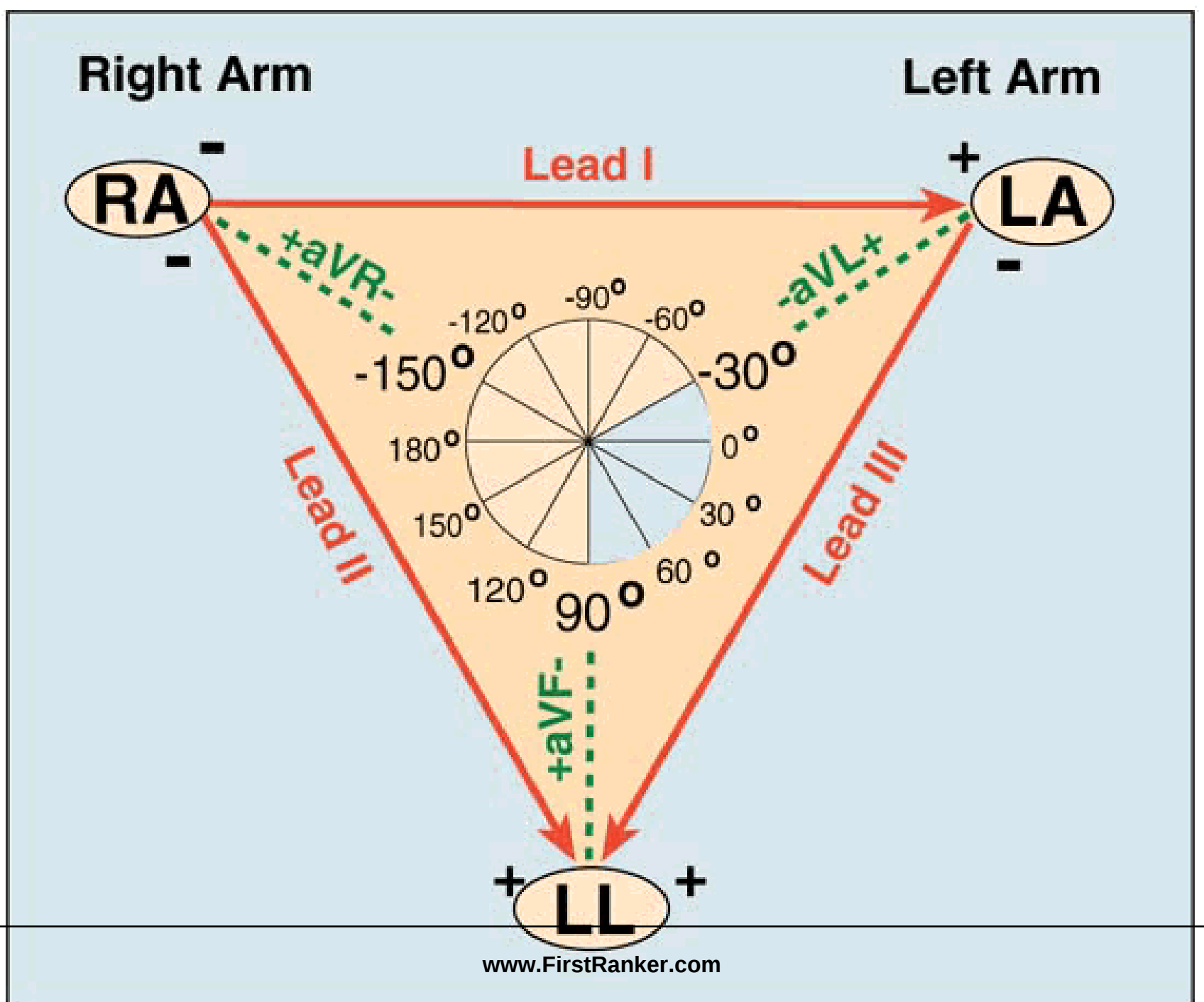
$$2 aVL = 2 VL - (VR + VF)$$

$$VL + VR + VF = 0$$

$$VL = - (VR + VF)$$

$$2 aVL = 2VL + VL$$

$$aVL = 3/2 VL$$



Thank You

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