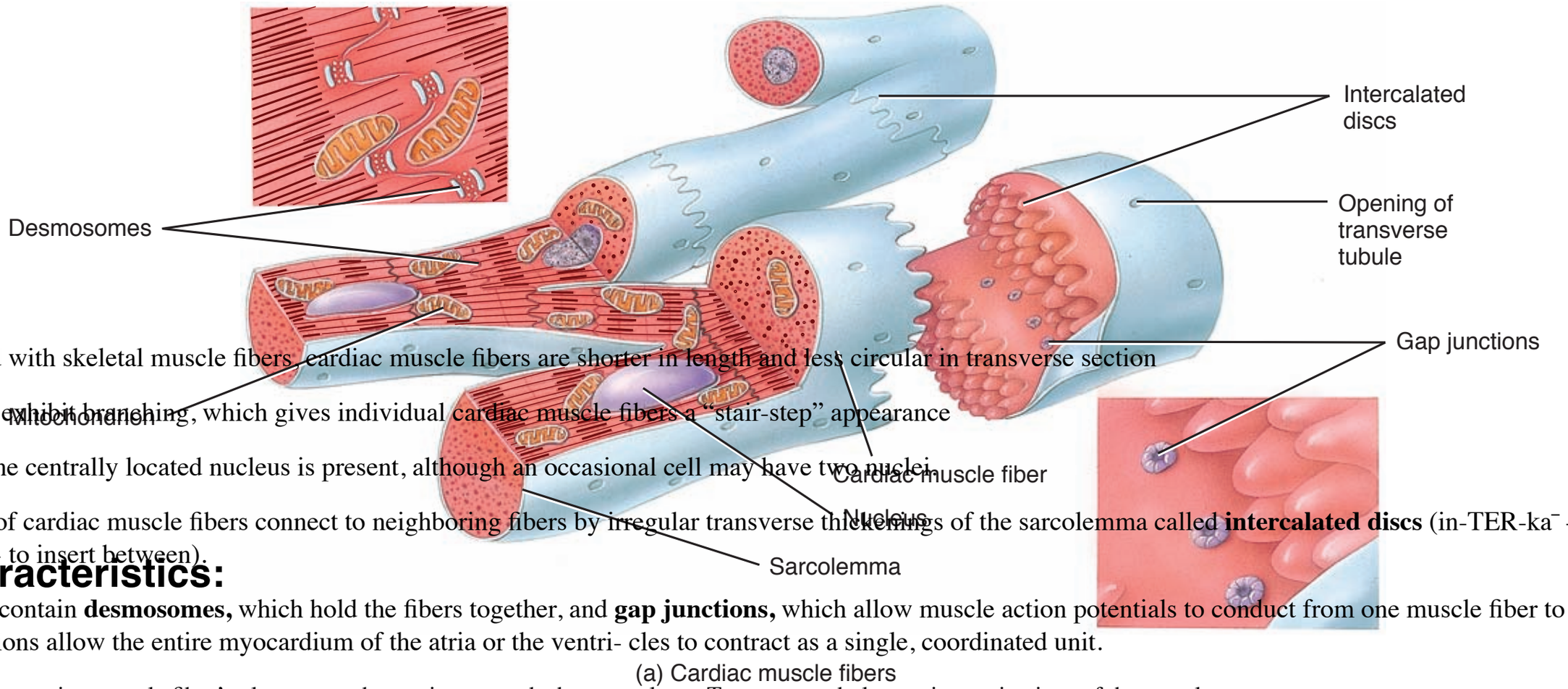
CARDIAC MUSCLE

L= 50-100 micrometer
d= 14micrometer

Cardiac muscle fibers connect to neighboring fibers by intercalated discs, which contain desmosomes and gap junctions.



(a) Cardiac muscle fibers

Compared with skeletal muscle fibers, cardiac muscle fibers are shorter in length and less circular in transverse section

They also exhibit branching, which gives individual cardiac muscle fibers a "stair-step" appearance

Usually one centrally located nucleus is present, although an occasional cell may have two nuclei.

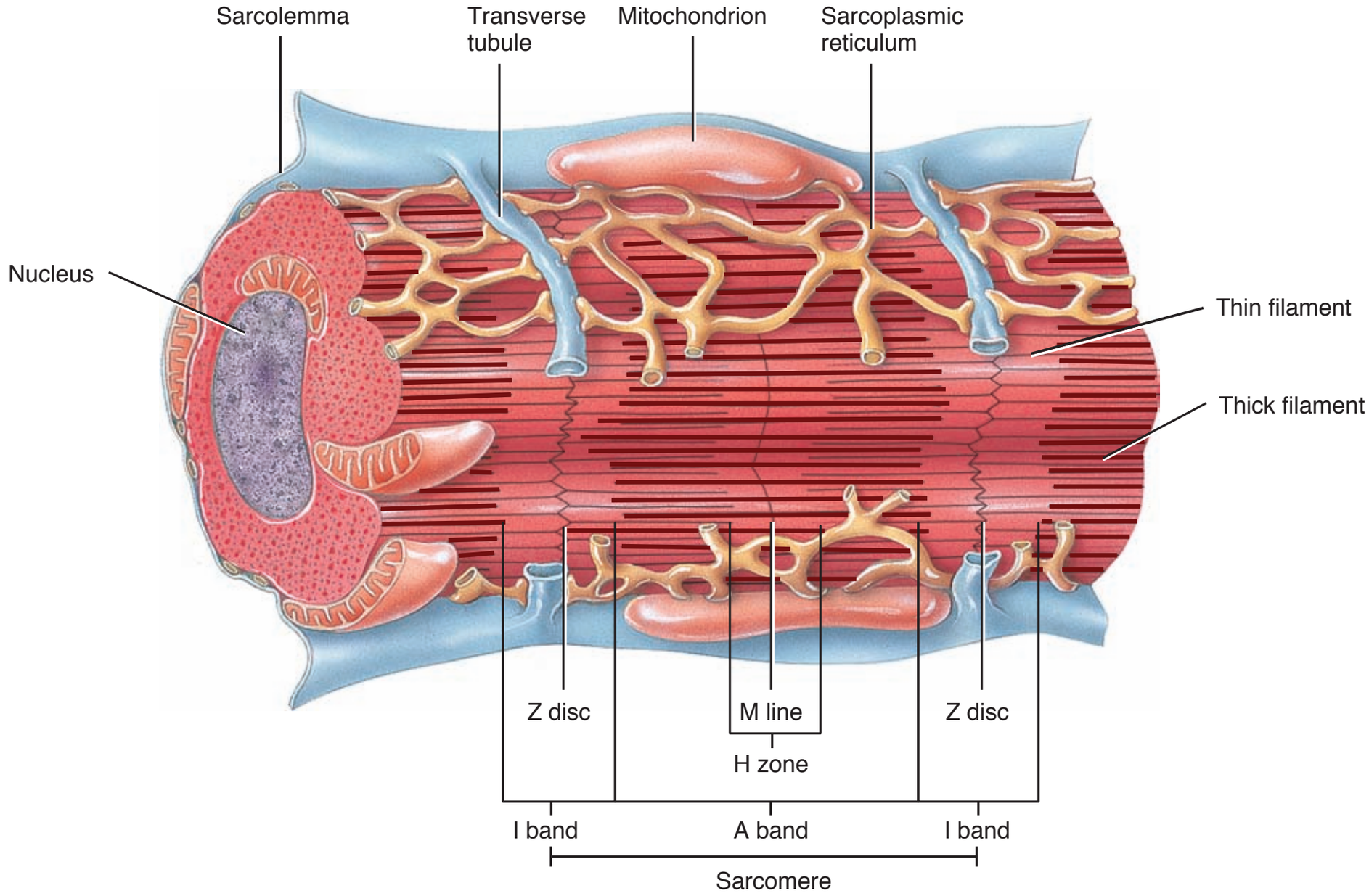
The ends of cardiac muscle fibers connect to neighboring fibers by irregular transverse thickenings of the sarcolemma called **intercalated discs** (in-TER-ka¯ -la¯ t-ed; *intercalat-* to insert between).

characteristics:

The discs contain **desmosomes,** which hold the fibers together, and **gap junctions,** which allow muscle action potentials to conduct from one muscle fiber to its neighbo
Gap junctions allow the entire myocardium of the atria or the ventri- cles to contract as a single, coordinated unit.

The sarcolemma is a muscle fiber's plasma membrane; it surrounds the sarcoplasm. Transverse tubules are in- vaginations of the sarcolemma.

Sarcoplasmic reticulum surrounds each myofibril. Within a myofibril are thin and thick filaments, arranged in compartments called sarcomeres.



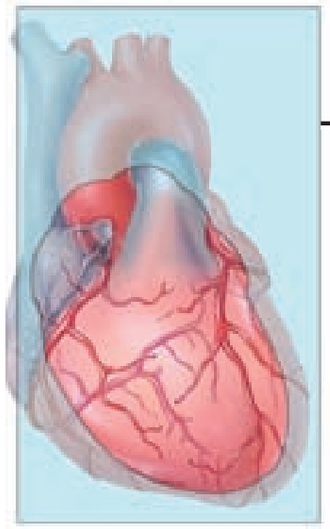
(b) Arrangement of components in a cardiac muscle fiber

Mitochondria is more numerous than in skeletal muscle (2%) taking 25%cytosolic space

AUTORHYTHMIC FIBERS : Repeatedly generate **Action Potentials** that trigger Heart contraction

- They act as “PACEMAKER” setting the rhythm of electrical excitation that causes contraction of the heart
- They form the “CONDUCTION SYSTEM” a network of specialised cardiac muscle fibers

THE CONDUCTING SYSTEM OF HEART



Frontal plane

Right atrium

1 SINOATRIAL (SA) NODE

2 ATRIOVENTRICULAR (AV) NODE

3 ATRIOVENTRICULAR (AV) BUNDLE (BUNDLE OF HIS)

4 RIGHT AND LEFT BUNDLE BRANCHES

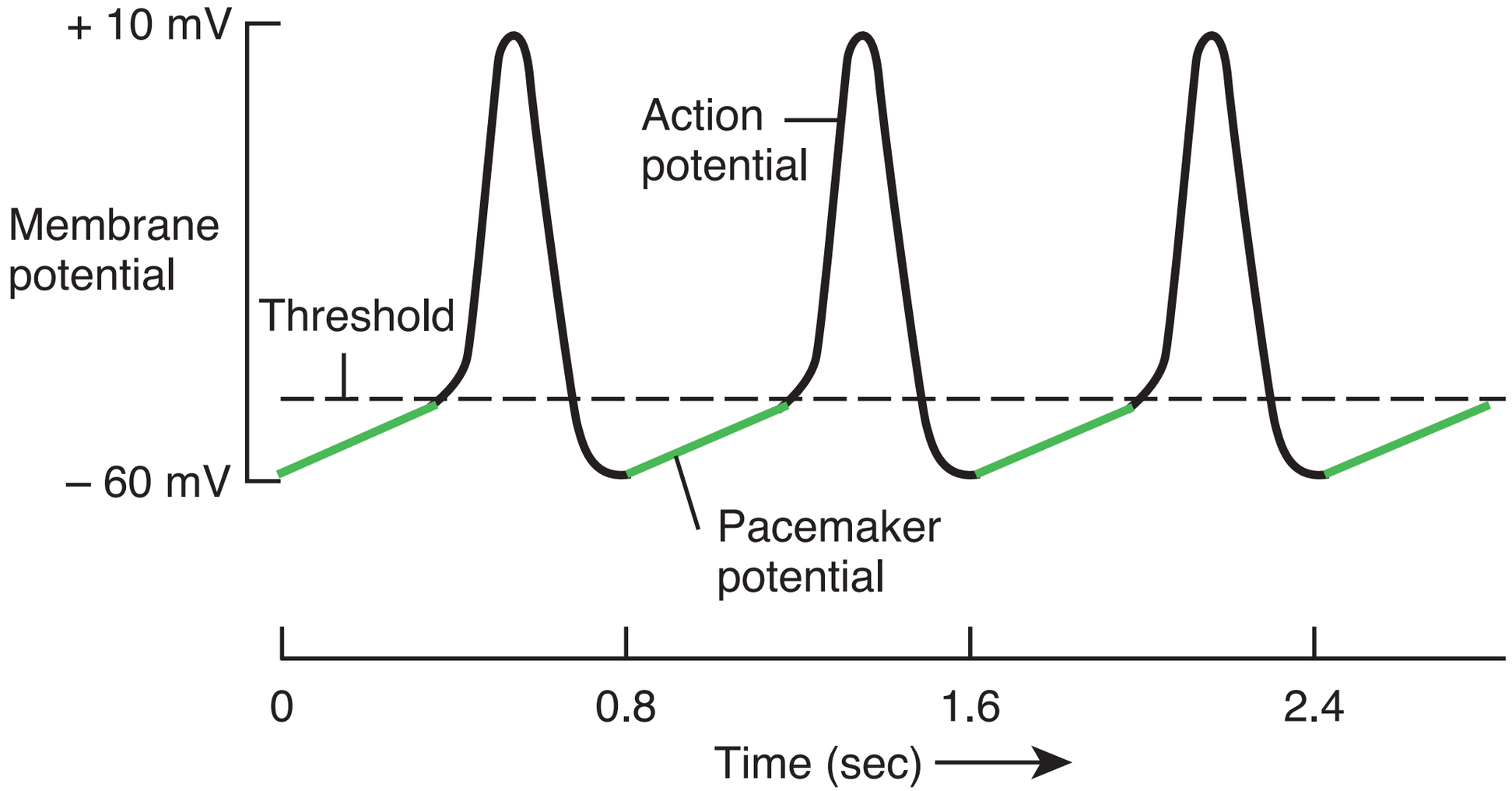
Right ventricle

5 PURKINJE FIBERS

Left atrium

Left ventricle

(a) Anterior view of frontal section

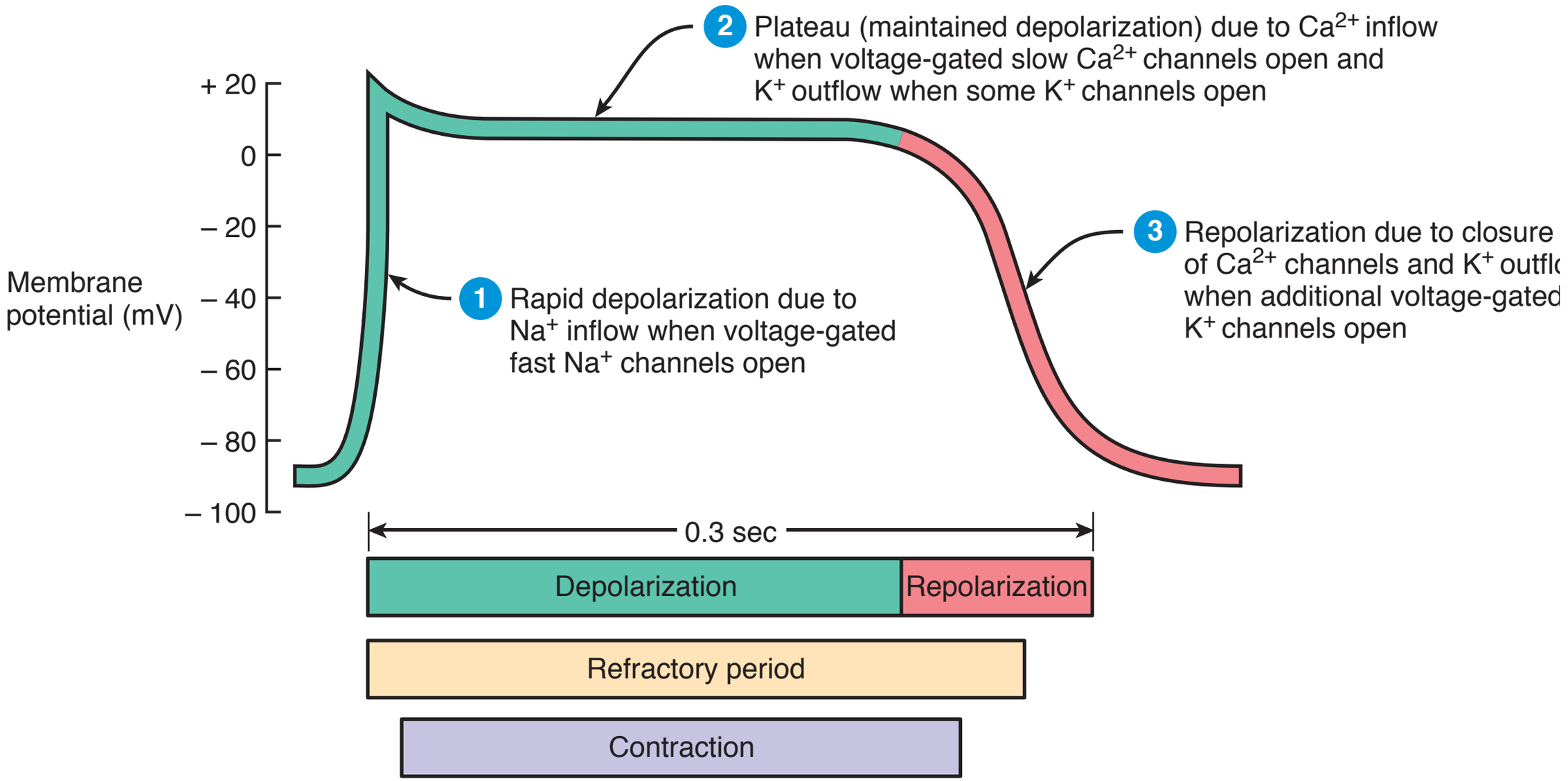


(b) Pacemaker potentials and action potentials in autorhythmic fibers of SA node

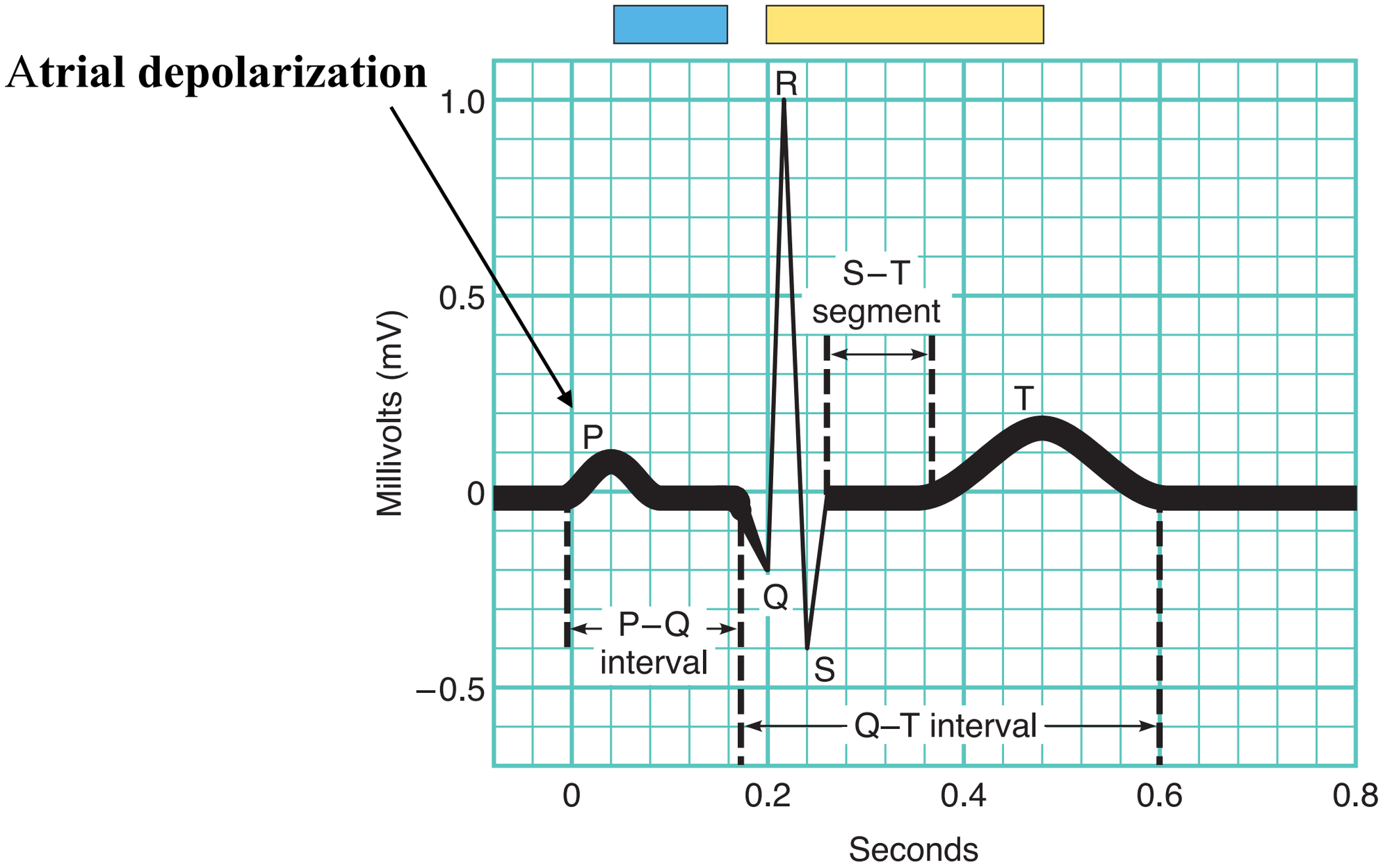
Autorhythmic fibers in the SA node would initiate an **Action potential** about every 0.6 seconds or 100 times /min

SA node is a natural **pacemaker** of the heart

ACTION POTENTIAL IN A VENTRICULAR CONTRACTILE FIBRE



ELECTROCARDIOGRAM



The ECG is a composite record of action potentials produced by all the heart muscle fibers during each heartbeat.

The instrument used to record the changes is an **electrocardiograph.**

- The first, called the **P wave,** is a small upward deflection on the ECG. The P wave represents **atrial depolarization,** which spreads from the SA node through contractile fibers in both atria.

- The second wave, called the **QRS complex,** begins as a downward deflection, continues as a large, upright, triangular wave, and ends as a downward wave.

The QRS complex represents **rapid ventricular depolarization ,** as the action potential spreads through ventricular contractile fibers.

- The third wave is a dome-shaped upward deflection called the **T wave.** It indicates **ventricular repolarization** and occurs just as the ventricles are starting to relax.

- The T wave is smaller and wider than the QRS complex because repolarization occurs more slowly than depolarization.

During the plateau period of steady depolarization, the ECG tracing is flat.

Analysis of an ECG also involves measuring the time spans between waves, which are called **intervals** or **segments.**

For example:

- The **P-Q interval** is the time from the beginning of the P wave to the beginning of the QRS complex. It represents the conduction time from the beginning of atrial excitation to the beginning of ventricular excitation. As the action potential is forced to detour around scar tissue caused by disorders such as coronary artery disease and rheumatic fever, the P-Q interval lengthens.
- The **S-T segment,** which begins at the end of the S wave and ends at the beginning of the T wave, represents the time when the ventricular contractile fibers are depolarized during the plateau phase of the action potential. The S-T segment is elevated (above the baseline) in acute myocardial infarction and depressed (below the baseline) when the heart muscle receives insufficient oxygen.
- The **Q-T interval** extends from the start of the QRS complex to the end of the T wave. It is the time from the beginning of ventricular depolarization to the end of ventricular repolarization. The Q-T interval may be lengthened by myocardial damage, myocardial ischemia (decreased blood flow), or conduction abnormalities.
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Why ECG is important?

- In reading an ECG, the size of the waves can provide clues to abnormalities.
- Larger P waves indicate enlargement of an atrium;
- an enlarged Q wave may indicate a **myocardial infarction**;
- and an enlarged R wave generally indicates enlarged ventricles.
- The T wave is flatter than normal when the heart muscle is receivin insufficient oxygen—as, for example, in coronary artery disease.
- The T wave may be elevated in Hyperkalemia (high blood K level)