Bioengineering 3202 Notes
Lecture #8, March 27, 2006
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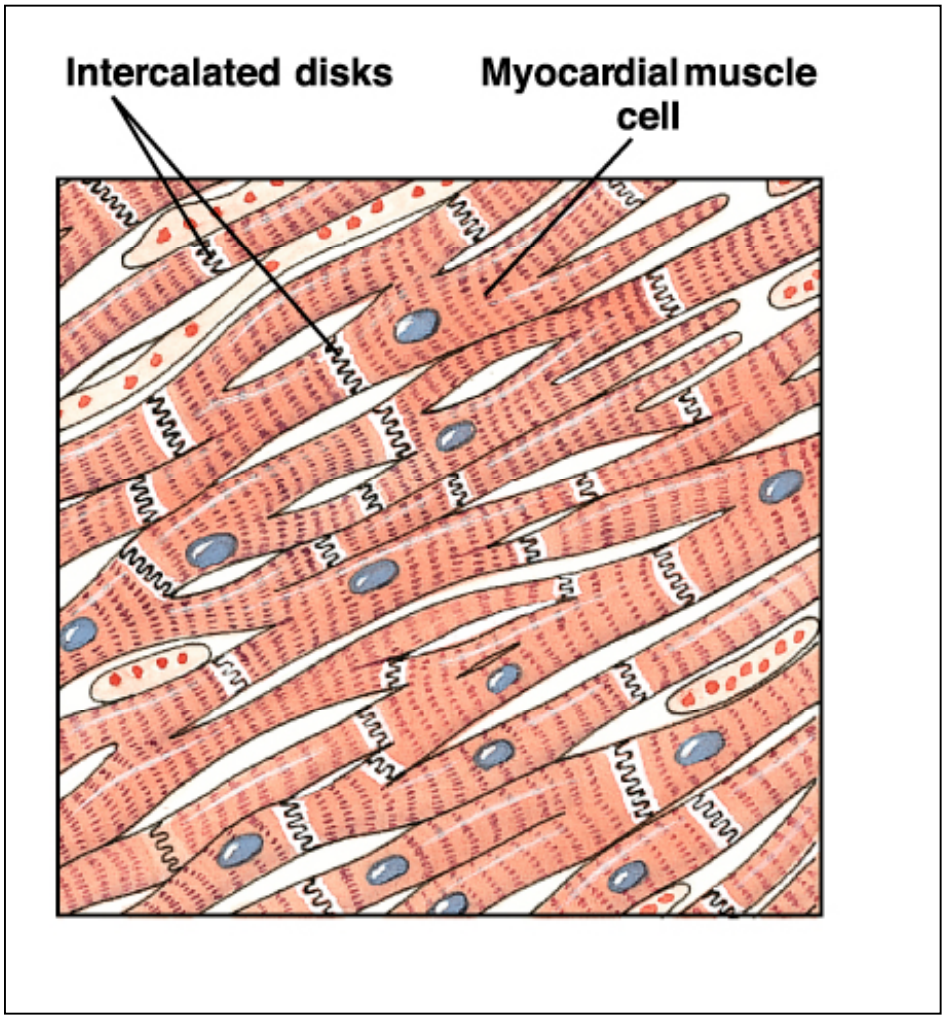
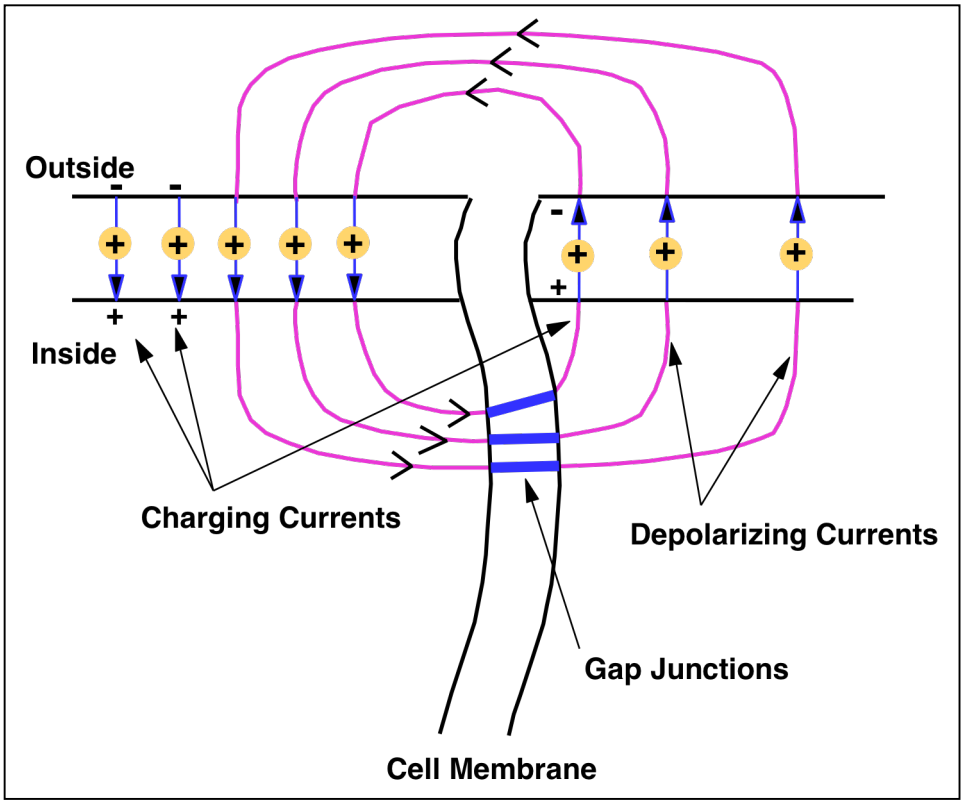
Vocabulary:
-syncitium
-gap junctions
-intercollated disks
-ansiotrophy ex.
-isotrophic ex. Water, same in all directions

Structure:
Heart cells are usually about 100 µm long, and 10-20µm across. These look like bricks with rough edges and form junctions, preferentially end-to-end.



Cell-to-cell coupling: how heart cells communicate



-Action potential: the chemical release- changes membrane characteristics in cells downstream. Neurotransmitters cross junctions, communicate across receptor, and depolarize.

Gap junctions: exist in almost every part of the body, essential for cardiac cells to communicate, these are like channels or tubes- which are usually open. They are pretty large, they let most ions through. There are a lot of channels between cardiacmyocytes- when one cell depolarizes, the ions pass though the junction to the next cell. (see diagram above for details)

Ions flow because of the electrochemical gradient (electrochemical gradient= concentration difference and the potential difference). Aside: Ca^{2+} concentration changes cause the heart to contract, but the concentrations of other ions do not change during the action potential.

The potential difference is formed and current flows into the 2nd cell. When the charge in the 2nd cell brings the potential to threshold, it will fire an action potential and the process repeats with the 3rd cell and so on until all cells have been stimulated.

To have current flow at all, there must be a complete loop and the external space carries the return current in this case. This current is essentially passing through the membrane

by means of the capacitive function of the bilipid layer. Like all capacitors, there is no real charge movement across the membrane but rather a build up of charge on one side changes the charge on the other side a creates a potential difference that drives the current.

When cells are close to each other, they form gap junctions. All heart cells are connected by gap junctions so that if one heart cell is stimulated, the whole heart contracts.

Anisotropy: Cells couple end to end and junctions are usually at the end of a cell. The cell stimulation pattern is anisotropic (anisotrophy is a function of orientation, it is not the same in all directions) usually in an elliptical shape. The rotation of fibers change orientation throughout the depth of the ventricular wall. It has a twisty ellipsoidal motion. The cells also only shorten along one axis.

The figure below shows the rotating fiber direction that one sees by taking histological slices parallel to the epicardial surface of the heart. The graph on the right shows the extend and pattern of fiber rotation through the ventricles.