

Frog Heart

In this experiment, you will explore basic principles of cardiac muscle physiology by recording force of contraction and the electrocardiogram (ECG). You will examine the effects of temperature, stretch, drugs on the heart, and conduction blockade, on the frog heart *in situ*.

Written by staff of ADInstruments, Exercise 5 written by Dr. Valerie G. Kalter, Department of Biology and Health Sciences, Wilkes University, Wilkes-Barre, Pennsylvania, USA.

Background

Studies of isolated organs were pioneered in the late 19th century when scientists such as Sidney Ringer (1835-1916) developed perfusion solutions (such as Ringer's solution) based upon the composition of the extracellular fluid that could sustain an organ isolated from a pithed animal. A classic example of an isolated organ preparation is the frog heart. It will continue to beat *in situ* for several hours, during which basic cardiac functions can be investigated.

The heart is made up of cardiac muscle. Cardiac muscle is similar to skeletal (striated) muscle, but exhibits some special properties, the most important of which is rhythmicity. All cardiac muscle cells have the inherent ability to depolarize and repolarize. These action potentials spread to adjacent cells via gap junctions that allow ions to move; thus current flows from cell to cell. In this way the atria and the ventricles behave as electrical syncytia. These spontaneous cycles of depolarization and repolarization occur in rhythmic fashion, giving rise to an intrinsic, regular heartbeat. In the intact, normal heart, the heart rate is determined by the group of cells – the pacemaker cells – that undergo the fastest depolarization/repolarization cycle. In the mammalian heart, the pacemaker cells are located in the sinoatrial (SA) node. In the frog heart, the sinus venosus is the functional equivalent of the mammalian SA node (Figure 1).

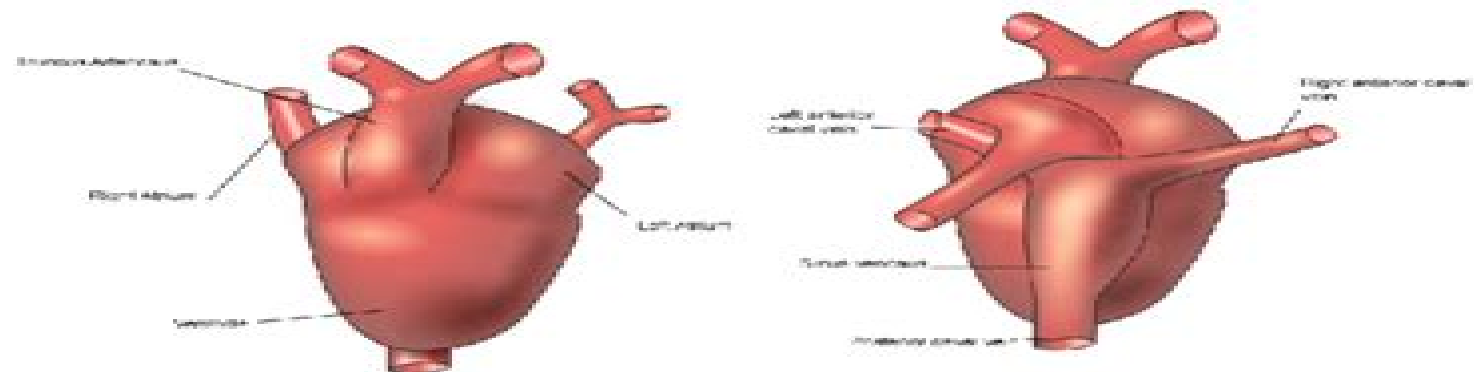


Figure 1. Ventral and Dorsal Views of the Frog Heart

As well as cell-to-cell current flow, there is a specialized conduction pathway. This provides the only electrical connection between the atria and ventricles – the AV node. Although there are pacemaker cells here, conduction is much slower than it is through either atrial or ventricular muscle. This allows the depolarization of the atria (and

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Table of Contents Lab Reports On Frog Heart Physiology

1. Understanding the eBook Lab Reports On Frog Heart Physiology
 - The Rise of Digital Reading Lab Reports On Frog Heart Physiology
 - Advantages of eBooks Over Traditional Books
2. Identifying Lab Reports On Frog Heart Physiology
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Lab Reports On Frog Heart Physiology
 - User-Friendly Interface
4. Exploring eBook Recommendations from Lab Reports On Frog Heart Physiology
 - Personalized Recommendations
 - Lab Reports On Frog Heart Physiology User Reviews and Ratings
 - Lab Reports On Frog Heart Physiology and Bestseller Lists
5. Accessing Lab Reports On Frog Heart Physiology Free and Paid eBooks

- Lab Reports On Frog Heart Physiology Public Domain eBooks
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- Lab Reports On Frog Heart Physiology Budget-Friendly Options
- 6. Navigating Lab Reports On Frog Heart Physiology eBook Formats
 - ePub, PDF, MOBI, and More
 - Lab Reports On Frog Heart Physiology Compatibility with Devices
 - Lab Reports On Frog Heart Physiology Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Lab Reports On Frog Heart Physiology
 - Highlighting and Note-Taking Lab Reports On Frog Heart Physiology
 - Interactive Elements Lab Reports On Frog Heart Physiology
- 8. Staying Engaged with Lab Reports On Frog Heart Physiology
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Lab Reports On Frog Heart Physiology
- 9. Balancing eBooks and Physical Books Lab Reports On Frog Heart Physiology
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Lab Reports On Frog Heart Physiology
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Lab Reports On Frog Heart Physiology
 - Setting Reading Goals Lab Reports On Frog Heart Physiology
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Lab Reports On Frog Heart Physiology
 - Fact-Checking eBook Content of Lab Reports On Frog Heart Physiology
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development

- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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