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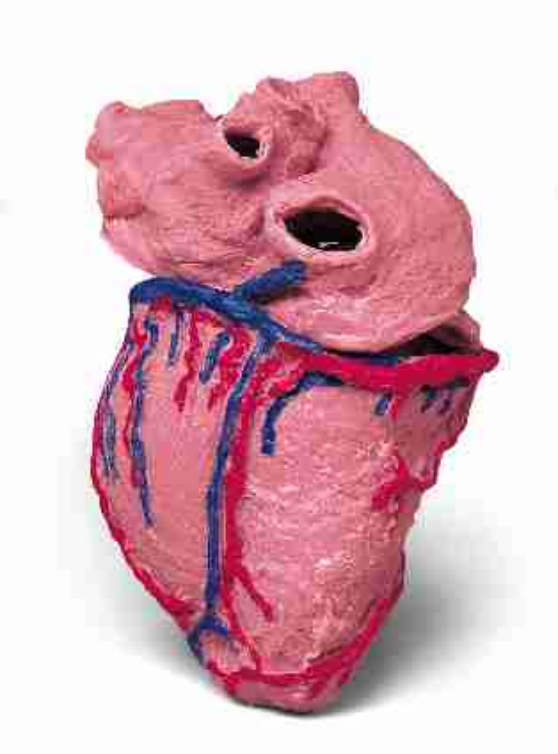
HUMAN HEART REPLICA LF00964 INSTRUCTION MANUAL



Life/form® Products by NASCO

About the Replica...

The Life/form® Human Heart Replica was molded and reproduced from a male cadaver heart of slightly greater than average size (about 350-400 g). It was free of pathology and can be regarded as a typical example of an adult human heart. It is assembled so that it can be opened to allow inspection of the chambers and the valves. The following sequence is presented as a logical way to examine the replica.

Exterior

The coronary arteries (red) and the cardiac veins (blue) were injected with rubber latex before removal of the visceral pericardium and fat. The average adult heart contains a variable amount of fat distributed mainly along the coronary vessels. Upon removal of this fat, both the veins and arteries were somewhat loose. They were restored to position during the molding process so that the pattern portrayed on the replica quite accurately mirrors the pattern one would see on a well-dissected cadaver heart.

The openings of the two coronary arteries can be seen by looking into the cut end of the ascending aorta, where two ostia are identified in red. The left coronary artery arises from the left aortic sinus above the left cusp of the aortic valve and the right coronary artery arises from the right aortic sinus above the ventral cusp of the aortic valve. Blood flow into the coronary arteries occurs mainly when the cusps of the valve are approximated by the diastolic blood pressure. At this time, the relaxed heart muscle allows the capillary bed within the heart muscle to expand. During contraction of the heart muscle (systole) the blood is forced into the cardiac veins and is returned to the right atrium. Note that the left coronary artery has been cut near its origin to permit manipulation of the cardiac skeleton forward.

The coronary blood supply in this specimen is balanced, i.e., the right coronary artery supplies the right side of the heart and the back of the interventricular septum; the left coronary artery supplies the left side of the heart and the front of the interventricular septum. Occasionally, one or the other of the arteries supplies a greater than usual portion of the back of the heart and is said to be dominant. For example, a dominant right coronary would continue into the left ventricular area on the back for a variable distance. The parent trunks (right and left coronary arteries) wind around the heart in a groove (atrioventricular or coronary sulcus) between the ventricles and the atria. The term "coronary" refers to the fact that these vessels form a "crown" around the top of the ventricles.

The cardiac veins accompany the branches of the coronary arteries. The large vein accompanying the circumflex branch of the left coronary artery is the coronary sinus. On the back of the heart, it can be seen where it enters the right atrium. By flipping the atria back, its ostium can be identified in the right atrium by the blue marking. The vast majority of venous blood from the heart musculature returns to the right atrium via the coronary sinus. A few small veins (anterior cardiac veins) empty directly into the anterior portion of the right atrium. These are not duplicated on the specimen. There are also some microscopic venous channels that empty directly into each chamber (smallest cardiac veins).

At the apex of the heart, some direct connections between the anterior and posterior interventricular branches can be seen. These are usually poorly developed and, as a rule, there are very few effective connections among the branches of the coronary arteries.

The thickness of the walls of the various chambers has been exactly duplicated. By squeezing the specimen it becomes obvious that the ventricles are thicker than the atria. The left ventricle is by far the thickest and the atrial walls are surprisingly thin.

The various large vessels entering and leaving the heart should be identified and their relationships established by careful inspection. Place the heart in front of you in the middle of the desk so that the apex points toward your right shoulder. This is about the position the heart occupies in the thoracic cavity. Elevating the apex about 1" from the desk surface gives an even more accurate position. The atria are thus posterior and superior and somewhat to the right of the ventricles. The heart itself is anchored to its pericardial bed by the veins entering the atria. The inferior vena cava opening is now approximately directed toward your right shoulder. It is almost in a direct line with the opening of the superior vena cava. Both return venous blood from the systemic circuit to the right atrium.

The four openings on the posterior aspect are for the pulmonary veins that return oxygenated blood from the lungs to the left atrium. On this specimen, which is typical, there are two right and two left pulmonary veins.

The two large vessels leaving the ventricles are the pulmonary artery (in front) and the aorta (behind and slightly to the right). Each of these arteries has three cusps that prevent backflow of blood into the ventricles during diastole (heart relaxed). Collectively, each is referred to as a semilunar valve. Each cusp is composed of a vascular fibrous tissue. The valves have been reproduced in the closed position to prevent damage by manipulation. Their inferior aspects can be inspected by flipping the cardiac skeleton forward.

Near the origin of the left coronary artery and slightly overlapping it is the auricle of the left atrium. This is the only portion of the left atrium that contains a substantial layer of cardiac muscle as indicated by the ridges seen from the inside. The right auricle is less striking in appearance being of a more rounded contour. A fairly substantial portion of the right atrium has raised muscular ridges on the inner wall (pectinate muscles).

Interior

Right Atrium:

By flipping the upper portion of the replica back, the right atrium can be inspected. Insert the left little finger into the opening of the inferior vena cava and note that it abuts against a thin oval portion of the interatrial septum. This is the fossa ovalis. In the fetus, this was an open passageway (foramen ovale) from the right to the left atrium. The thin oval area was the septum primum and the curved ridge above it (much thicker) was the septum secundum. The septum primum was not attached to this curved ridge (limbus of fossa ovalis) in the fetus, but was freely movable from right to left, thus acting as a valve flap. In the fetus, oxygenated blood from the placenta returned via the inferior vena cava through the foramen ovale to the left atrium. A small percentage of it, however, struck the free edge of the septum secundum and was diverted into the right atrium. In this way, both sides of the heart received some oxygenated blood in the fetus. Following birth, over a period of several months, the two septa fuse, resulting in the structures described.

Note that the region of the right atrium in line with the superior and inferior venae cavae is relatively smooth. This smooth portion of the chamber is the sinus venarum and represents what was the sinus venosus in the developing heart. The true atrial portion is defined by the pectinate muscles that form a comb-like arrangement (hence the term pectinate from "pecten" which is Latin for comb) radiating from a rather substantial raised ridge, the crista terminalis. With a finger still in the inferior vena cava, close the heart. Now feel the crista terminalis. Anteriorly and to the left (from the heart's point of view) is the true atrium and posteriorly and to the right is the sinus venarum. At the very top of the crista terminalis is the location of the sinoatrial node that serves as the pacemaker of the heart.

Now, with the heart opened, look down on the right atrioventricular canal. There are three valve flaps (tricuspid valve) guarding this passageway from the right atrium to the right ventricle. They are fused shut on the replica but, by holding the passageway to the light, one can distinguish three flaps. The free edges of these flaps approximate each other when blood is forced against their lower surfaces during contraction of the ventricle.

Left Atrium:

Now inspect the inside of the left atrium. This chamber, except for the muscular auricle previously mentioned, is essentially a smooth-walled expansion of the pulmonary veins. Note that the interatrial septum, as viewed from this side, does not show the interesting contours seen from the right. The left atrioventricular canal is guarded by two valve flaps (bicuspid valve). These flaps are fused on the replica but the line of fusion can be seen by holding them to the light.

Cardiac Skeleton:

The atria are separated from the ventricles by a fibrous skeleton. This fibrous area corresponds to the region surrounding the two atrioventricular canals and the openings into the aorta and pulmonary arteries. On the replica, this is the region that can be flipped forward to reveal the ventricular chambers. Care should be exercised to avoid tearing at the site of fusion.

The skeleton of the heart serves as the site of attachment for the cardiac muscle fibers. The atrial fibers attach to its upper surface and the ventricular fibers attach to its lower surface. There is no continuity between atrial and ventricular fibers. Both ends of the ventricular muscle sheets attach to the skeleton and they wind in a spiral-like fashion around the ventricles. During contraction, they squeeze the walls inward and upward propelling the blood toward the aortic and pulmonary outlets.

Right Ventricle:

With the cardiac skeleton flipped forward, the right ventricular chamber can be inspected. Notice that the chamber is semilunar in outline and extends anteriorly and to the left where the root of the pulmonary trunk begins. The right atrioventricular canal is located posteriorly and to the right. The muscular ridges are the trabeculae carneae. One of the papillary muscles is seen near the right floor of the chamber. The chordae tendinae were not duplicated. These thin, tough strands of connective tissue attach the free edges of the valve flaps to the papillary muscles.

Contraction of the papillary muscles occurs in synchrony with contraction of the muscles of the ventricular walls. This means that when the chamber is compressed, the relaxation of the chordae tendinae is prevented by contraction of the papillary muscles so that the valve leaflets will not balloon (evert) into the atrial chamber.

The muscular wall of the right ventricle is about one-third the thickness of the left ventricular wall. At birth, they are of equal thickness.

Left Ventricle:
The left ventricular chamber is shaped more like a cone that the right chamber. The atrioventricular canal is posterior and to the left; the aortic outlet is anterior and to the right. The two large papillary muscles can be seen extending upward from the floor. Their relationship to the valve leaflets via chordae tendinae is similar to that described for the right ventricle. The trabeculae carneae are more prominent in the left ventricle.

Blood Flow Through the Heart:
Flow of the blood through the heart in sequence should now be easily followed. Blood in the venae cavae enters the right atrium from whence it enters the right ventricle through the right atrioventricular canal. Upon contraction of the ventricle, blood leaves via the pulmonary artery to enter the capillary bed of the lungs. It returns to the left atrium via the pulmonary veins, enters the left ventricle through the left atrioventricular canal and leaves the left ventricle via the aorta. The capillary bed of the systemic circuit drains ultimately into the venae cavae and the circuit is now completed.

Care of the Replica
Never place the replica on newsprint or any kind of printed paper or plastic. These materials will transfer an indelible stain. Ballpoint pen ink will also make an indelible stain.

Normal soil accumulated on the surface of the replica can be removed with mild soap (Ivory® liquid soap) and lukewarm water. Use REN cleaner (W09919U) to remove stubborn stains from the simulator. Simply spray soiled area and wipe clean with a soft cloth or paper towels.

Supplies for the Human Heart Replica:

W09919U	REN Cleaner

Other Available *Life/form*® Simulators

LF00698U Adult Injectable Arm (White)
LF00856U Female Catheterization
LF00901U Prostate Examination
LF00906U Ostomy Care
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LF00958U Pediatric Injectable Arm
LF00961U Intramuscular Injection
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LF00999U Pediatric Injectable Head
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LF03622U Intraosseous Infusion Right Leg
LF03623U Infant Airway Management Trainer
LF03626U Child Femoral Access Injection Pad Replacement
LF03632U Child Intraosseous Infusion/ Femoral Access Leg on a Stand
LF03633U Child Airway Management Trainer with Torso
LF03693U **Basic Buddy** CPR Manikin
LF03699U "Airway Larry" Airway Management Trainer
LF03720U **Baby Buddy** Infant CPR Manikin
LF03953U ***CRiSis™*** Manikin
LF03955U Deluxe ***CRiSis™*** Manikin
LF03965U Deluxe "Plus" ***CRiSis™*** Manikin
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LF04021U ***KERi™*** Basic Manikin
LF04022U ***KERi™*** Advanced Manikin
LF04030U ***GERi™*** Advanced Manikin
LF04040U ***GERi™*** Basic Manikin
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LF06200U **CPR Prompt™** Keychain Rescue Aid
LF06200U **CPR Prompt™** Rescue and Practice Aid

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