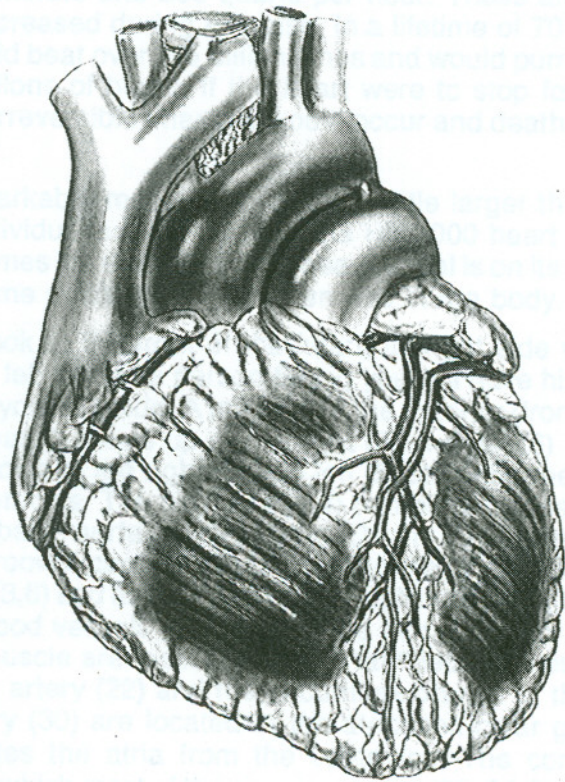


Human Heart Reproduction

Danny Smith Heart

HE-2000



Laerdal™
helping save lives

THE HEART

The heart is a muscular organ that acts as a double pump; the right side receives deoxygenated blood from the body and pumps it to the lungs while the left side receives the oxygenated blood from the lungs and pumps it to the rest of the body. The atria act as the receiving chambers of the heart and ventricles as the pumping chambers.

The heart begins to beat toward the end of the first month of embryonic development and must continue to beat for the duration of the individual's life. With each beat, the heart pumps about 2 ounces (60 milliliters) of blood. This amounts to about 5 quarts per minute and 300 quarts per hour. These amounts are greatly increased during exercise. In a lifetime of 70 years, the heart would beat over 2½ billion times and would pump over 50 million gallons of blood. If the heart were to stop for even a short time, irreversible changes would occur and death would quickly follow.

This remarkable muscular pump is a little larger than the size of an individual's clenched fist. The HE-2000 heart model is about two times life size. When the heart model is on its stand, it is in the same position as it is when it is in the body.

As you look at the front of the heart, its right side will be opposite your left just as a person facing you will have his right side opposite your left side. A majority of the anterior (front) surface of the heart is made up of the right (3) and left (6) ventricles. The auricles of the right (2) and left (5) atria are seen just above the ventricles. The two atria (1,4) can be better seen on the posterior (back) surface of the heart. On the outside surface of the heart, grooves can be seen separating the atria, (1,4) from the ventricles (3,6) and also separating the right ventricle (3) from the left (6). Blood vessels which provide a rich supply of blood to the heart muscle are located in these fat-filled grooves. The right coronary artery (22) and the circumflex branch of the left coronary artery (30) are located in the atrioventricular groove which separates the atria from the ventricles. The coronary sinus (34) into which most of the coronary veins (33, 35-38) drain is also located in the atrioventricular groove on the back of the heart. The anterior (28) and posterior (26) interventricular arteries are located in the intraventricular groove which separates

the right and left ventricles. On the inside of the heart a partition (the interatrial septum) separates the two atria and another septum (the interventricular septum, 61) separates the two ventricles.

The direction of blood flow through the heart is indicated by arrows on the inside of the model. The heart receives blood by way of the veins and pumps it out through the arteries. On the model, vessels which contain deoxygenated blood are blue, while those which contain oxygenated blood are red. Observe the heart model with the doors on the right side open and the doors on the left side closed. Deoxygenated blood from the upper part of the body, drains into the superior vena cava (7) and then into the right atrium (1). Blood from the lower part of the body enters the right atrium through the inferior vena cava (8). From the right atrium, the blood passes through the tricuspid valve (50) into the right ventricle (3). When the ventricles contract, the blood is pumped through the pulmonic valve (52) into the pulmonary trunk (12) and then to the lungs by way of the pulmonary arteries (13, 14). The pulmonary trunk and arteries transport deoxygenated blood and are, therefore, color-coded blue. At this point open the doors on the left side of the heart. Oxygenated blood from the lungs returns to the left atrium (4) of the heart through the pulmonary veins (15). After passing through the bicuspid (mitral) valve (51) into the left ventricle (6), the oxygenated blood is pumped through the aortic valve (53) to be distributed throughout the body by the aorta (16) and its branches (17-19, 21).

With the four doors of the heart model open, note the thickness of the muscular walls of each chamber; the atria have considerably thinner walls than the ventricle. This difference reflects the fact that the atria act as receiving chambers of the heart and the ventricles as the pumping chambers.

Each of the four chambers has its own characteristic appearance, structures and related vessels. The thin-walled-right atrium (1) receives deoxygenated blood by way of the vena cavae (7,8) and from the heart itself by way of the coronary sinus (34) and anterior cardiac veins (32). The coronary sinus (34) drains into the right atrium just to the left of the opening of the inferior vena cava (See 43 in right atrium). The fossa ovalis (44) marks the location of the foramen ovale, an opening in the fetal heart wall which permitted blood from the right atrium to enter the left atrium, thus bypassing the lungs. The wall of the anterior part of

the right atrium which includes the auricle (2), consists of parallel muscular ridges called pectinate muscles (49). The pectinate muscles end on a smooth muscular ridge called the crista terminalis (48). Two important structures associated with the conduction system of a heart, the sinoatrial (SA) node (46) and the atrioventricular (AV) node (47) are located in the wall of the right atrium. The SA node (46) is located at the upper end of the crista terminalis at the junction of the atrium and the superior vena cava. Electrical impulses which cause the heart to contract rhythmically, originate from the SA node (46) which is often referred to as the "pacemaker." The impulse spreads from the SA node to the right and left atria and to the AV node (47) which is located in the interatrial septum just above the orifice of the coronary sinus (43). The atrioventricular bundle transmits the impulse from the AV node through the septum dividing the atria from the ventricles, into the musculature of the interventricular septum (61). In the septum, branches of the conduction system (59, 60) transmit the impulse to the ventricular musculature which results in the ventricles contracting and pumping blood.

The outer wall of the right ventricle is much thicker than the walls of the atria, but thinner than those of the left ventricle. A portion of the walls of the right ventricle are lined with irregular muscular ridges and bulges called trabeculae carneae (58). Blood flows from the right atrium into the right ventricle through an opening guarded by the tricuspid valve (50). The valve, as its name indicates, is made up of three cusps or leaflets. Tendinous cords called chordae tendineae, extend from the edges of the cusps (like cords of a parachute) to cone-shaped muscular projections from the ventricular wall called papillary muscles (57). When blood passes through the valve into the ventricles, the cusps are pushed aside. When the ventricles contract, the pressure of the blood forces the cusps together to close the valve to prevent back flow. The papillary muscles contract with the ventricles and the chordae tendineae are tightened to keep the cusps in position and prevent them from being pushed up into the atrium. With the tricuspid valve closed, contraction of the ventricle pumps the blood through the pulmonic valve (52) which on the model is located on the door of the right ventricle.

Oxygenated blood from the lungs enters the left atrium (4) of the heart through four pulmonary veins (15). The openings of these veins are not guarded by valves. The inner walls of the left atrium are smooth except in the auricle (5) where parallel ridges called pectinate muscles (49) are present.

The walls of the left ventricle are approximately two to three times the thickness of the right ventricle. Most of the left ventricular wall is covered with a fine network of irregular muscular ridges and bridges called trabeculae carneae (58). The valve located between the left atrium and the left ventricle is called the bicuspid valve (51). This valve is commonly referred to as the mitral valve because of the resemblance of its two cusps to a bishop's "Mitre." The bicuspid valve is similar in construction and function to that of the tricuspid valve, except that it has only two cusps. When the ventricles contract, blood is pumped from the left ventricle through the aortic valve (53) into the aorta (16).

The first branches of the aorta are the left (27) and right (22) coronary arteries. On the model, the origin of the left coronary artery is shown on the inside of the aorta just above the aortic valve (53). The origin of the right coronary artery is in the portion of the aorta which is on the door of the right atrium.

On the back of the model, one can see two structures which lie close to the heart. The trachea (39) is a tubular structure which is supported by C-shaped cartilage rings. It is the main passageway through which air from the nose and mouth flows to the lungs. The esophagus (41) is a muscular tube through which food passes from the mouth to the stomach.

KEY CODE

1. Right atrium
2. Auricle of right atrium
3. Right ventricle
4. Left atrium
5. Auricle of left atrium
6. Left ventricle
7. Superior vena cava
8. Inferior vena cava
9. Brachiocephalic (innominate) veins
10. Inferior thyroid vein
11. Azygos vein
12. Pulmonary trunk
13. Left pulmonary artery
14. Right pulmonary artery
15. Pulmonary veins
16. Aorta
17. Brachiocephalic trunk (innominate artery)

18. Left common carotid artery
19. Left subclavian artery
20. Ligamentum arteriosum
21. Intercostal arteries
22. Right coronary artery
23. Anterior right atrial branch of right coronary artery
24. Superior vena caval (nodal) branch of right atrial artery
25. Right marginal artery
26. Posterior interventricular (posterior descending) artery
27. Left coronary artery
28. Anterior interventricular (anterior descending) artery
29. Diagonal branch of anterior interventricular artery
30. Circumflex branch of left coronary artery
31. Left marginal artery
32. Anterior cardiac veins
33. Great cardiac vein
34. Coronary sinus
35. Posterior vein of left ventricle
36. Oblique vein of left atrium
37. Middle cardiac vein
38. Small cardiac vein
39. Trachea
40. Left and right bronchi
41. Esophagus
42. Valve of inferior vena cava
43. Orifice of coronary sinus
44. Fossa ovalis
45. Valve of foramen ovalis
46. Sinoatrial (SA) node
47. Atrioventricular (AV) node
48. Crista terminalis
49. Pectinate muscles
50. Tricuspid valve
51. Bicuspid (Mitral) valve
52. Pulmonic valve
53. Aortic valve
54. Supraventricular crest
55. Moderator band
56. Septal band
57. Papillary muscles
58. Trabeculae carneae
59. Left and right branches of the atrioventricular bundle (of His)
60. Purkinje fibers
61. Muscular interventricular septum

Norway: LAERDAL MEDICAL AS
P.O. Box 377, N-4002 Stavanger
Tel. +47 51 51 17 00, Fax +47 51 52 35 57
E-mail: laerdal.norway@laerdal.no

Australia: LAERDAL Pty. Ltd.
(ABN 47 003 817 490)
23 Edward Street, Oakleigh, Victoria 3166
Tel. +61 3 9569 4055, Toll free 1800 331 565
Fax +61 3 9569 4028, Toll free 1800 635 835
E-mail: customer.service@laerdal.com.au

BeNeLux
for Belgium: Laerdal BeNeLux n.v.
Business Park Luchthavenlaan,
Jan Olieslagerslaan 33, B-1800 VILVOORDE
Tel. +32 2 253 36 96, Fax +32 2 253 36 90
E-mail: laerdal.benelux@laerdal.no

The Netherlands:
Welcomé in "The Laerdal BeNeLux House"
Dijkstraat 54, NL-5554 PS VALKENSWAARD
Tel. +31 40 208 58 00, Fax +31 40 208 58 02
E-mail: Laerdal.benelux@laerdal.no

Canada: LAERDAL MEDICAL CANADA LTD.
151 Nashdene Rd., Unit #45
Toronto, ON, Canada, M1V 4C3
Tel. +1 (416) 298-9600, Toll free 888/LAERDAL (523-7325)
ou en français (800) 567-9987
Fax +1 (416) 298-8016
E-mail: savelives@laerdal.ca

Denmark: LAERDAL DANMARK
Postbox 225, DK-8600 Silkeborg
Tel. +45 80 333 112, Fax +45 80 333 555
E-mail: laerdal.denmark@laerdal.no

Eastern Europe: LAERDAL C.E. EUROPE
A-1060 Vienna, Mariahilferstr. 1d/1/3
Tel - Fax +43 15877140, Tel. +43 15815927
E-mail: mstam@aon.at

Far East: LAERDAL Singapore Pte Ltd
No 1 Marine Parade Central
#13-05, Parkway Center
Singapore 449408
Tel. +65 63464259, Fax +65 63467523
E-mail: admin@laerdal.com.sg

Finland: LAERDAL OY
Vattuniemenranta 2, 00210 HELSINKI
Puhelin +358 (0)9-612 99 80,
Telekopio +358 (0)9-692 77 99
E-mail: laerdal.finland@laerdal.no

France: LAERDAL MEDICAL FRANCE
Bâtiment n° 5 - 1 rue des Vergers - 69760 Limonest
Tel. +33 (0)4 72 52 02 52, Fax +33 (0)4 78 35 38 45
E-mail: laerdal.france@laerdal.no

Germany: Laerdal Medical Deutschland GmbH
Am Lofersfeld 56, 81249 München
Tel. +49 (0)89 / 864 954-0, Fax +49 (0)89 / 864 34 84
E-mail: info@laerdal.de

Italy: Laerdal Italia s.r.l.
Via Piero Gobetti 52/2 int.Z, 40129 Bologna
Tel. +39 051-355587, Fax +39 051-355598
E-mail: Laerdal.italia@laerdal.no

Japan: LAERDAL MEDICAL JAPAN K.K.
Park West Bldg. 10F
6-12-1, Nishi-Shinjuku, Shinjuku-Ku, Tokyo 160-0023
Tel. +81-3-3346-1861, Fax. +81-3-3346-1862
E-mail: laerdal.japan@laerdal.co.jp

Malaysia: Laerdal Hospiline Sdn Bhd
12 Jalan Titir 33/25, Section 33, Shah Alam Technology Park
40400 Shah Alam, Selangor Darul Ehsan
Tel. +60 (3) 522-7002, Fax +60 (3) 522-5650
E-mail: sales@hospiline.com

New Zealand: Laerdal New Zealand Ltd
(GST Number 79-403-639)
PO Box 302664, North Harbour, Auckland 1330
Tel. +61 3 9564 4066, Toll Free 0800 523 732
Fax +61 3 9563 3368, Toll Free 0800 528 852
E-mail: customer.service@laerdal.co.nz

Portugal: Laerdal Espana, Sucursal em Portugal
Rua da Bela Vista à Graca, no.31 A. Escritorio 9,
1170-054 Lisboa
Tel. (+351)-21-816-6567, Fax (+351)-21-816-6568,
Mob. (+351)-918765367

Spain: Laerdal Espa_a S.L.
Manuel Tovar 19, 28034 Madrid
Tel. (+34) 902-291110, Fax (+34) (91) 7291125
E-mail: laerdal.spain@laerdal.no

Sweden: LAERDAL MEDICAL AB
Box 2064, 132 02 Saltsjö-Boo
Tel. +46 (0)8-55614610, Fax (+46) (0)8-55614619
E-mail: kontakt@laerdal.se

United Kingdom: LAERDAL MEDICAL LTD.
Laerdal House, Goodmead Road, Orpington,
Kent BR6 0HX
Tel. +44 (0)1689 876634, Fax +44 (0)1689 873800
E-mail: customer.service@laerdal.co.uk

USA and Latin America:
Laerdal Medical Corporation
167 Myers Corners Road, P.O. Box 1840
Wappingers Falls, New York 12590-8840
Tel. (800) 431-1055, +1 (845) 297-7770
Fax (800) 227-1143, +1 (845) 298-4545
E-mail: customerservice@laerdal.com

Medical Plastics Laboratory, Inc.
226 F.M. 116, P.O. Box 38
Gatesville, Texas 76728-0038
Tel. (800) 433-5539, +1 (254) 865-7221
Fax +1 (254) 865-1150, +1 (254) 865-8011
E-mail: services@mpltx.com