Introduction

Husky Dogs

The systems involved with movement and include the skeletal, muscular, nervous, cardiovascular respiratory, renal, hormonal, gastrointestinal and skin. All these system put together allows them to sustain long periods of sprinting, leaping and jumping in order to maintain their predatory status. (Sports Medicine Veterinary Supplies)

When a dog exercises there is an increase in joint flexibility and muscle tone. Regular exercise not only helps develop new bone growth but also helps strengthen existing bone. Younger dogs however should resist prolonged or excessive exercise until bones have stopped growing. The increase in muscle tone can help with the dog’s alignment which can also reduce the risk of injury. As the heart muscle strengthens, it is capable of pumping out larger volumes of blood along with vital nutrients and oxygen. The immune system is boosted and reduces the risk of arthritis in later life. Other benefits include reduced digestion problems and constipation and increases circulation and metabolic rate which helps lower blood pressure, reducing the risk of respiratory and heart disease, diabetes and obesity. (Nutrecare)

All exercise should start with a warm up to allow the blood flow to gently increase which in turn will help reduce the risk of injury and be finished off with a cooling down session so that any metabolic waste such as lactic acid that has been produced during exercise can be removed. This will help prevent any soreness in the muscles. (Nutrecare)
**The Husky Dog at Rest**

**Muscles**
Muscles (see figure below) are used in propulsion and navigation of the body and the skeleton provides support and structure to the body. (Sports Medicine Veterinary Supplies)

![Muscles of a Dog](image)

(Sports Medicine Veterinary Supplies)

**Respiratory System**
The respiratory system is responsible for gaseous exchange and thermoregulation – taking in oxygen and eliminating waste gases like carbon dioxide and is made up of the mouth and nose, trachea and the lungs (see figure below). (Sports Medicine Veterinary Supplies)

![Lungs](image)

(Washington State University)
The normal respiratory rate for a full sized Husky at rest is between 16 to 20 breaths per minute. (Vet Info)

**Circulatory System**

During rest, the right side of the heart pumps blood from the body into the lungs. This is called the pulmonary circulation. Within the tissues of the lungs, deoxygenated blood diffuses carbon dioxide from the blood within the thin-walls of the capillaries into the alveoli of the lungs, produced during their metabolic processes and is expired. At the same time blood in the lung capillaries picks up oxygen from inspired air. (Aspinall & O’Reilly)

The left hand side of the heart pumps oxygenated blood and nutrients from the lungs through an intricate network of blood vessels to the rest of the body. This is called systemic circulation. (Aspinall & O’Reilly)

The figure below shows the lower chambers which are called the right and left ventricles that pump blood out of the heart. When the heart contracts, blood squeezes through the atrioventricular valve or tricuspid valve from the right atrium into the right ventricle. The mixing of deoxygenated and oxygenated blood is prevented by the septum that separates the right and left halves. The purpose of all valves is to prevent the backflow of blood, ensuring that blood flows in one direction only. (Aspinall & O’Reilly)

![Inside View of the Heart](Washington State University)

On the second contract, the right ventricle sends blood to the lungs via the pulmonary arteries at the base of which contains the pulmonary valve that prevents backflow into the right ventricle. (Aspinall & O’Reilly)

Oxygen rich blood enters the left atrium from the lungs via pulmonary veins where it is then carried to every part of the body except the lungs. (Aspinall & O’Reilly)
Capillaries are small vessels that form a vast network called capillary beds (see figure below). The main function of capillaries is to exchange nutrients, oxygen and waste between the blood and tissue fluids that surround cells. As the capillaries are small in diameter, blood slowly flows through them allowing fluids and gases to move by diffusion between the blood and the tissues, the rate of which is determined by the gradient of concentration between the interstitial fluid and plasma. The venules are the smallest veins that collect deoxygenated blood from capillary beds and return it to the heart of via the veins. (Aspinall & O'Reilly)

AVA’s or arteriovenous anastomosis are small blood vessels with a thick muscular coat that connects an arteriole directly to a venule, bypassing capillaries. These thoroughfare channels are always open and play an important role in shunting. (Aspinall & O'Reilly)

![Capillary Beds](Florida State College)

The walls of the heart are made up of three layers of tissue – the inner and outer epithelial tissue and the middle cardiac muscle layer called the myocardium which has a rich supply of oxygenated blood. This cardiac muscle is myogenic or self excitible which means that it is able to contract rhythmically and automatically without the control of the nervous system and its tissue cells contain mitochondria that guarantee each cell has a constant supply of ATP. (Aspinall & O'Reilly)

(Scan figure 7.4 page 89 showing nodes from book)
A husky’s heart beats between 70 to 120 times per minute and its blood pressure is 120/80. (Vet Info)

The heart beats by sending an impulse from the heart’s natural pacemaker, the sino-atrial node through the cardiac muscle cells in the right and left atrium causing both atria to contract over the heart like a wave. The SA node initiates each heartbeat, sets the pace of the heart race and can be adjusted by nerves, hormones, temperature and exercise. It is made up of a small bundle of specialised heart muscle cells embedded in the right atrium. The impulse is relayed and delayed by the SA node and reaches the atrioventricular node or AV node that is located in the septum through special muscle fibres called Purkinje fibres. The electrical impulse from the AV node then travels to a large bundle of Purkinje fibres called the Bundle of HIS, moving quickly to the septum that divides the muscles cells in the two ventricles, causing them to contract a fraction of a second after the atria. This action completes a full heartbeat and causes the chambers to squeeze the blood up from the bottom of the ventricle to the top where the blood leaves through the pulmonary arteries and the aorta. (Toole)

Blood pressure is controlled according to the diameter of the blood vessels. Vasoconstriction narrows the vessels which causes the pressure to rise, similarly vasodilation or widening of the vessels causes a fall in blood pressure. Both these actions are controlled by the vasomotor centre in the medulla oblongata, the part of brain that coordinates cardiovascular and ventilation. The nerve receptors that influence the heart are pressure sensors “baroreceptors” that detect the change in blood pressure in the carotid and aortic sinuses and relay this message to the vasomotor centre. Baroreceptors are also found in airways and if the carbon dioxide concentration rises so will the blood pressure which increases the speed of delivery of blood to the lungs so that it can be removed more quickly. (Toole)

Chemoreceptors in the carotid and aortic bodies of the blood system can sense minute changes in chemical stimuli within the blood, mainly carbon dioxide, blood pH, oxygen. When the levels of carbon dioxide rise, these chemoreceptors send nerve impulses to stimulate the inspiratory centre to pass the impulse along the phrenic and thoracic to the diaphragm and intercostal muscles to contract faster and therefore cause increased inspiration. (Toole)

The Bohr effect is the reduction of the affinity of haemoglobin for oxygen when carbon dioxide is increased and pH levels are lowered.

Nerve effectors – directly (heart, arteriole muscles) and indirectly (via endocrine system – hormones, ie adrenalin fight or flight, epinephrine from adrenal gland that increases heart rate)

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**During Exercise**

The circulatory system plays an important role while exercising as it links the sites of the energy storage and gas exchange with the mitochondria of working cardiac and skeletal muscle. (Sports Medicine Veterinary Supplies)

The arrows in the drawing below shows force of movement backwards and forwards of each joint. (Animal Anatomy)
The movement of a Husky’s Front and Hind Legs

As the muscle begins to exercise, the sympathetic nervous system stimulates an increased heart rate and the arterioles serving the muscle dilate due to an increase in carbon dioxide, hydrogen ion, K+ and osmolarity, thus increasing blood flow by 20 times. As exercise is prolonged, the rate is sustained not only by nervous factors but also by the adrenal glands increasing their hormonal flow. (Washington State University)

During intense exercise the Husky’s blood pressure will increases to 220/75 and blood and body temperatures will rise. The blood delivers the heat to the capillaries that help release this excess heat by rapidly release it to the tissue. (Vet Info)

More venous return blood load (stimulates SA node) plus increased co2 in blood from respiration……..

Recovery Phase

Once exercise has ceased, the haemoglobin in the blood replenishes the myoglobin store….. expand (Toole)
Conclusion
References

Websites


Books