

## Does heart rate affect lifespan? And

### How much volume does your heart pump per beat? AKA: What is your Stroke Value?

In order to determine this figure, you need to calculate a few other values first.

You will also need to know several terms:

- How much blood your heart pumps in one minute is called cardiac output (CO).
- How much blood is pumped per minute for every square meter of body surface area is called cardiac index (CI).
- A weight and height to body surface area chart is called a nomogram. (There is one attached at the end of this packet.)
- How many beats your heart pumps per minute is called your heart rate (HR).
- How much blood the heart pumps for every square meter of surface area is the cardiac index (CI).
- How much blood your heart pumps in one beat is called stroke volume (SV).
- Your body's surface area in square meters is called you body surface area (BSA).

**Important:** In order to calculate your SV you need to know your CO and your HR and for your CO you need to know your BSA in square meters.

**To find your body's surface area (BSA)**, first use a scale and measuring tape to (and a little factor label method) determine your weight in kilograms and your height in centimeters.

Weight = \_\_\_\_ (kilos) Height = \_\_\_\_ (cm)

On a nomogram find your weight in the right column and your height in the left column. Place a straightedge on the nomogram so the weight and height are connected. The point where the straightedge crosses the center column denotes your body's surface area (BSA) in square meters.

You can also determine this BSA by the following calculation:

$$BSA = \text{SQRT}( (cm*kg)/3600 )$$

**Calculate your cardiac output by the following:**

$$CO=BSA(CI)$$

How much blood the heart pumps for every square meter of surface area (cardiac index) varies with the age of the individual. For children ages 10-13, the average cardiac index is 2.75 liters /minute/m<sup>2</sup> at a resting state and for adults it is 3 liters/minute/m<sup>2</sup>. The normal range for cardiac index is approximately 2.6-4.2 liters/minute/m<sup>2</sup>. A cardiac index less than 2.5 liters/minute/m<sup>2</sup> may indicate mild left heart failure. Shock is suggested by a cardiac index less than 1.8 liters/minute/m<sup>2</sup>. Use the adult 3 liters/minute/m<sup>2</sup> for your calculation.

How does your volume per minute compare to a 2 liter beverage bottle?

Use the factor label method to show how much blood is pumped in an hour and how much is pumped in a day.

**To calculate your stroke volume** you need to measure your heart rate.

Count your beats per minute using a clock with a second hand and record your heart rate: \_\_\_\_\_

$$SV = \text{Cardiac Output} / \text{Heart rate}$$

Convert the stroke volume to milliliters.

Use a graduated cylinder to carefully measure this number of millimeters of water. Pour it into a cup. This is the volume of blood pumped by your heart in one beat. Compare your value to the volumes of two other members of your household using your value as the actual value and theirs as the experimental value.

Seal up your volume of water and bring it with you when you return to school.

### **Extensions**

A mouse's heart beats about 700 times per minute and an elephant's about 30. A mouse lives less than three years, an elephant more than 60. Is there a connection? Explain.

Research the heart rates of various animals. Does there appear to be a relationship between size of animal and heart rate?

Research the longevity of various animals and compare this to their heart rate. Is there a relationship between the average lifetime of an animal and its heart rate?

