

### LET'S EXPLORE: ELECTROCARDIOGRAMS

During each heartbeat, an electrical pulse causes the cardiac muscles to contract, which causes the iconic blood-pumping activity of the heart. Have you ever wondered how to read an electrocardiogram (ECG)? Let's explore by simulating your own heartbeat. First, how old are you?

Age:

**Prompt 1:** User is introduced to the topic, prompted to submit age.

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Great! Now, place two fingers on your carotid artery as pictured in the diagram below. You'll feel the rhythmic throbbing of your heart pumping blood through your arteries, or **pulse**.



Now, feel the rhythm of your pulse and then click the button below to match the same rhythm of your own heartbeat for **15 seconds**. Watch as the graph below print the electrocardiogram of your pulse.

Click Pulse

Timer: 0:10



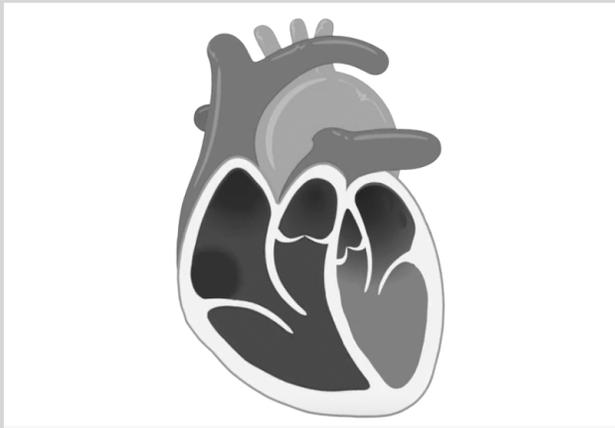
Electrocardiogram (ECG)

**Prompt 2:** User is instructed on how to obtain carotid pulse, prompted to click the pulse for 10 seconds whilst a simulated ECG counts off the clicks. If the user does not click two seconds after the previous, the timer will reset. Values for beats per 10 seconds will be carried over for heart rate prompts.

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Looks good! Now, what does this electrocardiogram tell us about heart physiology? Watch the animation below. Notice how the peaks in the graph align with ventricular contraction?

Now, let's explore! Press the pause and play buttons to toggle the ECG on and off. You can also use the slider to explore the ECG and compare the graph to the heart's muscular contractions. To view your heart's electrical nodes in action, check the box. Click "Next" to move on.



Show Nodes

NEXT ►

**Prompt 3:** User's pulse is visualized with an ECG and an animated heart is synched to the graph. Users can pause the heart animation and scrub through a segment of the ECG to view the cardiac events taking place in that segment of the graph. Users can click the "show nodes" button to animate the cardiac nodes firing electrical signals across the heart. A next button brings them to the following prompt

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So, can you calculate your heart rate with the info we've collected so far? Yes! We can calculate your **average resting heart rate** with the following equation:

$$\frac{10}{\text{heart beats in 10 seconds}} \times 6 = \frac{60}{\text{average resting heart rate per min.}}$$

For adults, the average resting heart rate is between 80 and 100 beats per minute, and can be 40-60 beats per minute for well-trained athletes. Your **maximum heart rate** can be calculated with the following easy equation:

$$220 - \frac{25}{\text{age}} = \frac{195}{\text{maximum heart rate per min.}}$$

During physical activity, your **target heart rate** range lies between 50-85 percent of your maximum heart rate. So, in summary, your numbers are as follows:

Average Resting Heart Rate: 60  
Maximum Heart Rate: 195  
Target Heart Rate (lower range): 98  
Target Heart Rate (upper range): 166

NEXT ►

**Prompt 4:** Users' input data from earlier in the simulation is used to calculate heart rate measures. These measures are displayed for the user to understand. A "next" button takes the user to the final prompt.

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Now let's bring it all together! Experiment with this sim on your own. Do your friends have similar heart rates and rhythms?



Show Nodes

Age  Click Pulse Timer: 0:15

Average Resting Heart Rate: 60  
Maximum Heart Rate: 195  
Target Heart Rate (lower range): 98  
Target Heart Rate (upper range): 166

NEXT ►

**Prompt 4:** Users are invited to use all of what they've learned to play around with the sim on their own, and add other values to experiment. A "next" button brings users to the assessment questions.