

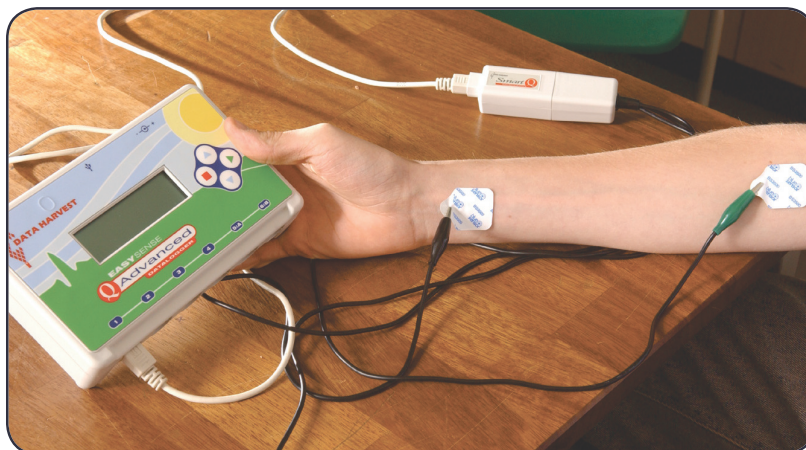
## Preface and acknowledgments

There are 75 experiments presented in this volume. They are arranged as a set of teacher's notes followed by the student's worksheets. The worksheets and teacher's notes can be photocopied for use within the purchasing institute. The accompanying CD includes the setup files referred to in the Student's worksheets and will be automatically installed into the **EASYSense** software.

It is hoped the experiments will make it easier for teachers to introduce data logging to students in a meaningful manner. The experiments cover a wide range of ability levels and curriculum requirements. They have been organised into topic areas, where possible. Within each topic area a higher experiment number indicates a more complex or challenging experiment.

These experiments have been written after use in a classroom and they have come from many sources. It is not the intention to suggest they are original, they are experiments that users have told us are useful in teaching science or for introducing students to data logging.

A correct assessment of the safety risks associated with the experiment should be carried out by the teachers conducting the experiments. The inclusion or exclusion of safety information is not an indication of responsibility by the publisher. Teachers must follow local safety regulations and advice to ensure the safety of the teacher and students is maintained. Disposal and use of chemicals associated with the experiments should follow local regulations.



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## Teacher's notes

### 1T - Pulse

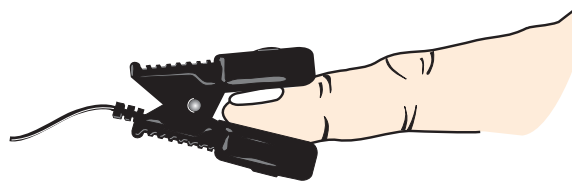
#### Read

This simple experiment uses the waveform range of the Heart Rate sensor. The waveform range produces an output of mV against time and produces a trace on the screen which will look familiar to anyone who has watched a medical drama or been in a hospital.

The sensor works by sending a beam of infrared light through the finger, blood absorbs the infrared. As the heart beats, it increases blood flow. In the capillaries of the extremities the extra flow will give an increased blood volume. The increased blood volume will block more infrared light. During the period between the beat, blood will drain from the capillaries and less light will be blocked. The sensor measures the change in light levels and displays the result in mV.

When mV is plotted against time a visible waveform is produced, each high peak equates to the end of the heart contraction of each beat. The low point equates to the end of the rest period in the heart cycle.

The students will get a feeling for the pulse like nature of the heart beat and can calculate the heart rate by measuring the time interval between peaks and multiplying up to give beats per minute. Normally 6 peaks are used to give a better average reading. If less peaks are used you may see a lot of variation between sets. This is normal as the heart is a dynamic organ that responds to very slight changes in the body's demands.



#### Apparatus

1. An EASYSense logger.
2. 1 x Smart Q Heart Rate sensor - set to the waveform range (mV).

#### Setting up the software / logger

Use the setup file **01 Pulse**.

To manually set up the software / logger.

Recording method	Time	Intersample	
Graph	10 seconds	50ms	Overlay

### Extension Activity

Use the set up file **01 Pulse Scope**.

To manually set up Scope

Recording method	Timebase	Mode
Scope	20ms	Roll mode

### Notes

Strong light can potentially interfere with the sensor, if possible readings should be taken in shade or with the sensor covered with something light proof. In most classrooms this will not be a problem.

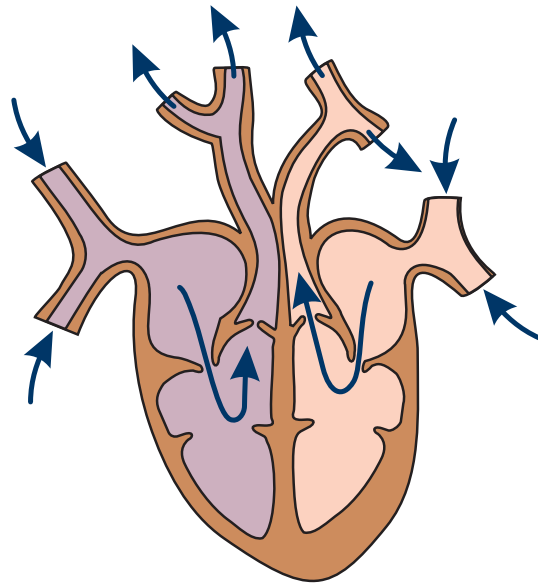
The sensitivity of the Heart Rate sensor is good enough to pick up changes in the heart rate due to very slight movements of the body. For best results the students should be encouraged to be still when readings are being taken.

If the heart rate appears erratic or is difficult to detect, try moving the finger/ear lobe clip. Position the clip so that the part without wire coming from it is on the finger nail. The best place to pick up the pulse will vary between individuals, the 'pointing finger' is a good starting place, but be prepared to try other fingers.

### Results

Students should use the **Interval** tool to find the time difference between peaks. The interval will appear in an information box. It might be useful to demonstrate how to use Interval before setting them off.

1. Check the time scale is in **Time (s)**.
2. **Add Text** is found by right clicking the mouse when the mouse pointer is on the graph area. Once text has been entered click on OK. You then need to point to where you want the text box line to start and click once more. Move the text box around to place it where it best fits or makes most sense. To edit the text, place the mouse pointer over the text box, right click and select Edit.



### Extension activity

1. Repeat this activity after exercise to compare resting heart rate with exercising heart rate.
2. Try using the **Scope** mode of **EASYSSENSE**, by using the **01 Pulse Scope** set up file. Click on **Start**, the pulse will be recorded and then start to scroll across the screen - a little like a heart rate monitor you may see in a hospital drama.

**Note:** There is a wide variation in people's heart rates. Children and adults with cold hands should rub their hands to improve the blood circulation before this activity.

**Sensors:** Heart Rate  
**Loggers:** Any EASYSense

**Logging time:** 10 seconds

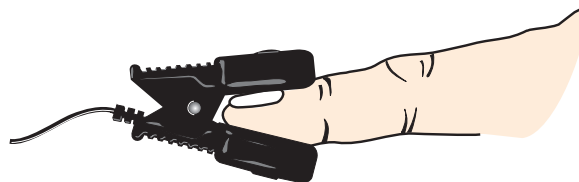
## 1 - Pulse

### Read

When your heart beats it pushes blood around the body. Each beat of the heart makes a pressure change in the blood vessels, this is called the pulse. The Heart Rate sensor sends an infrared beam (like the one that is used for the remote control for TV's) through the body, if there is not much blood present a lot of the light passes through, if there is a lot of blood then less light passes through.

If you are not convinced that light can travel through the body, hold your fingers over a torch (DO NOT USE A LIGHT BULB - IT WILL BURN YOU!!), make sure there are as few gaps as possible between your fingers, turn the torch on and look at the red glow created by light passing through the fleshy part of your fingers. You may need to darken the room slightly to see this.

Each pulse changes the volume of blood in the finger, the Sensor can measure the changes in light level with each pulse and present this as a 'waveform'. In this experiment you will monitor the 'waveform' and use it to measure the pulse.



### What you need

1. An EASYSense logger.
2. 1 x Smart Q Heart Rate sensor - Set to the waveform range (mV).

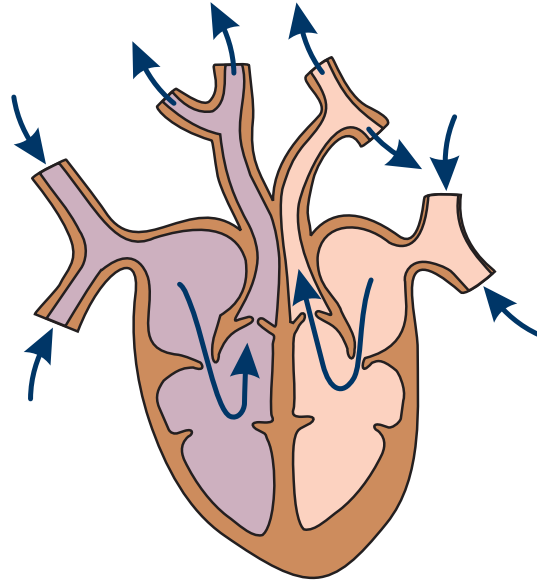
### What you need to do

1. Connect the Heart Rate sensor to input 1 of the EASYSense logger.
2. Start EASYSense and select **Open Setup** from the **Home page**. Open the set up file Data Harvest Investigations \ Setup files \ Biology L3 \ **01 Pulse**.
3. Place the sensor clip on to your finger, or to your ear lobe and check that the LED on the sensor is flashing on and off.
4. Click on **Start** to begin logging.
5. Repeat with another volunteer.

## Results



1. Showing one graph at a time, count the number of peaks and multiply by 6 to find out how many times your heart beats per minute.
2. Use **Add Text** to note your heart rate in beats per minute.
3. Repeat step 1 and 2 for all the graphs.



## Extension activities

1. Repeat this activity after exercise to compare a resting heart rate with an exercising heart rate.
2. Try using the **Scope** mode of **EASYSense**, by selecting the **01 Pulse Scope** set up file. Click on **Start**, the pulse will be recorded and then start to scroll across the screen - a little like a heart rate monitor you may see in a hospital drama.

**Note:** There is a wide variation in people's heart rates. Children and adults with cold hands should rub their hands to improve the blood circulation before this activity.