How to use the equipment in the box

These instructions are supplied as a summary – please refer to the detailed manufacturers’ instructions supplied with the individual pieces of kit. We advise that you read the separate sheet of general safety information on page 114 of this guide.

Pulse Oximeter

The pulse oximeter allows you to measure both percentage oxygen saturation in arterial blood and pulse rate.

- Do not use the oximeter in the presence of flammable mixtures.
- Avoid contact with water or extreme moisture, avoid storing where there is high dust content or chemicals, and shield from external light sources.
- The oximeter should be handled with care to avoid shocks and falls.
- When the oximeter is in use, ensure that the batteries have sufficient capacity.

- Don’t use pointed objects such as pens or nails to press the buttons, as permanent damage may be caused.
- Any nail varnish including clear should be removed as it may distort the values given.

Battery installation

- Push the battery cover, the blue panel on the underneath of the pulse oximeter, horizontally away from the white section.
- Install the two AAA cells with polarities correct, otherwise damage might occur.
- Batteries should be removed if the oximeter won’t be used for some time.
- Don’t use lithium cells, as they may damage the oximeter.
- Don’t mix different types of cell, e.g. zinc chloride and alkaline.

Operation

- Press the white function button on the front panel for about 1 second and then release it to turn the pulse oximeter on. The oximeter automatically switches off when there is no signal for more than 3 seconds.
- Press the top of the pulse oximeter where it is labelled PUSH and insert one finger fully into the opposite end before releasing the end marked PUSH. The nail surface must be inserted so it is upward.

- Put your lower arm and hand on a flat surface and wait for the readings on the pulse oximeter to become steady. You should wait approximately 10 seconds before taking any reading. Keep still during this time.
Peak Flow Meter

The peak flow meter measures peak flow – the maximum speed of air that a person can generate through a forced exhalation.

Operation

- The mouthpieces are for single person use only, so each student must use their own marked mouthpiece.
- Students should stand to take their readings.
- The pointer should be moved to the end of the slot nearest to the mouthpiece, below the 60 l/min mark, before students take their readings.
- The peak flow meter should be held so that fingers are clear of the pointer and slot.
- To measure peak flow students should take a deep breath in, place the peak flow meter in their mouth holding it horizontally, and close their lips around the mouthpiece. They should then blow as hard and as fast as possible into the peak flow meter.
- Students should note the number on the scale indicated by the pointer.
- After taking the reading, students should return the pointer to the starting position and repeat the procedure twice more.

Lung Volume Bag

The lung volume bag measures the capacity of the lungs (tidal volume and vital capacity).

Assembly

- The mouthpieces are for single person use only, so each student must use their own marked mouthpiece.
- Although disposable mouthpieces are being used any student with a cold should either not do their measurement or take their measurements after all the other students.
- Students should insert their mouthpiece halfway through the opening of the volume bag and secure it with a rubber band, twisting it four times.
- While sitting, students should hold the bag on their knee and press a paper towel against it to force the air out of the bag. They should start with the sealed end and push the air out toward the mouthpiece.
Measuring tidal volume

Expiratory tidal volume is the volume of air that is moved during one inhalation and exhalation when breathing normally.

- Students should take a normal breath in through their nose and take a normal breath out into the lung volume bag mouthpiece. Students should practise this technique before starting the measurement. For the measurement it is recommended that students do this for five complete breaths in order to get a measurable amount of air in total. Students with a particularly large tidal volume may fill the bag with five breaths so the number should be adjusted accordingly for such students. Likewise those students who have a particularly small tidal volume may need to complete 10 breaths into the bag.
- Once students have finished breathing into the bag they should hold the bag at the top, close to the mouthpiece and twist it around so that none of the air can escape.

Measuring vital capacity

Vital capacity is the size of your lungs – the maximum amount of air that you can exhale after breathing in the maximum amount of air you can.

- Students should breathe in the largest breath possible and breathe out as much air as possible into the lung volume bag through their mouthpiece.
- Once students have finished breathing into the bag they should hold the bag at the top, close to the mouthpiece, and twist it around so that none of the air can escape.
- While sitting, hold the bag on the knee and slide a paper towel along the bag to push all the air to the end and measure the volume of air it contains. (The bag has litre and 1/10 litre graduations.)
- Students can remove all the air from the lung volume bag by sliding the paper towel along its length from the sealed end towards the mouthpiece.
**Respirometer Kit**

The respirometer kit can be used to measure the amount of carbon dioxide in exhaled air, at rest, and after exercise.

**WARNING:** Students must take great care that they only breathe out into the respirometer and do not breathe in to avoid ingesting the bromothymol blue solution.

In the kit box you will find equipment for the respirometer kit:

- 1 × 2-litre plastic bottle
- 6 × bungs
- 6 × lengths of hard tubing
- 6 × lengths of flexible pvc tubing
- 6 × one-way valves
- 5 mg of bromothymol blue
- 100 ml of 0.1 M sodium hydroxide solution
- 6 × pipettes

For more than one station in the carousel of experiments, you will need to supply up to 5 × 2-litre plastic bottles. Make up the bungs with the hard and plastic tubing and non-return valve inserted as in the respirometer kit assembled for you in the kit box.

See the Technician notes on page 107 for how to make up the bromothymol blue indicator solution.

Carbon dioxide is acidic and will gradually turn the bromothymol blue/sodium hydroxide solution from blue to green at neutral, then yellow. If a known amount of sodium hydroxide is added before any carbon dioxide then you can get an estimation of how much carbon dioxide is breathed out because 2 moles of sodium hydroxide are required to neutralise 1 mole of carbon dioxide.

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\text{CO}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}
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Have two test tubes containing bromothymol blue solution for students to use for colour comparisons. If you then add a drop of a weak acid to one tube, they can see the colour change from blue to green at pH 7. They will be looking for the green colour, to show when the carbon dioxide in their breath has neutralised the sodium hydroxide added to the indicator solution. Students can also refer to the indicator charts supplied in the kit box. The charts are for universal indicator but both indicators change to green at pH 7.

You will need enough bromothymol blue solution to refill the respirometers three times (at 500 cm³) per group, and enough 0.1 M sodium hydroxide solution to add 5 cm³ to each respirometer of bromothymol blue per group.

**Using a pipette to measure the volume of sodium hydroxide solution.**
Blood Pressure Monitor

The blood pressure monitor measures systolic and diastolic blood pressure as well as pulse rate. The systolic blood pressure is the maximum blood pressure during a heart beat and the diastolic blood pressure is the minimum blood pressure during a heart beat. Pulse rate is the number of heart beats per minute.

WARNING: Great care must be taken not to overinflate the cuff as this could cause pain and/or injury (burst blood capillaries).

Please refer to the manufacturer’s instructions.

Battery installation

- Remove battery cover on the underneath of the monitor by gently pulling up the battery cover panel.
- Place 1 AA (1.5 volt) cell in the compartment with positive (+) and negative (–) terminals matching those indicated in the compartment.
- Replace cover by sliding it into the compartment and gently pressing into place.
- Rechargeable batteries will not work with this monitor.

Cuff size and position

- Using the correct cuff size is important for an accurate reading. The correct cuff size is printed on the fastening of the cuff with markings to show when a smaller or a larger cuff is needed. The cuff size provided will be suitable for most 16–19 year olds.
- Students should remove constricting clothing and place the cuff on the bare left arm.
- Students should sit comfortably with their left arm resting on a flat surface so that the centre of their upper arm is at the same height as their heart.
- They should lay their left arm on the table, palm up, and thread the cuff end through the metal loop, smooth side against the arm. Then they should position the tube off-centre toward the inner side of the arm in line with the little finger.
- Students should pull the end of the cuff to tighten it, fold back the extra material, and fasten securely. The cuff should be snug but not too tight. They should be able to insert two fingers between the cuff and their arm.

Operation

- Students should relax for at least 5 minutes before taking a reading.
- Students should not cross their legs and should keep their feet flat on the floor during measurement.
- When the cuff is in the correct position press the START button (blue/grey button in the bottom right corner of the monitor). Students’ average blood pressure reading will appear with the number of measurements stored in memory and a flashing Λ symbol, indicating that the monitor is ready for measurement.
- If the V symbol is displayed continuously, the cuff has some air trapped in it. Press the exhaust valve button until the Λ symbol is displayed. You may have to press on the cuff while holding the exhaust valve to release all the air in the cuff.
- When the Λ symbol is displayed flashing, begin cuff inflation by squeezing the inflator bulb repeatedly and continuously until the Λ symbol disappears, this may take a few seconds.
- Stop squeezing the inflator bulb when the Λ symbol disappears or until cuff pressure reaches about 30 mm Hg to 40 mm Hg above expected systolic pressure.
- When the correct pressurisation has been reached, the automatic exhaust mechanism will gradually reduce the pressure in the cuff. Sit quietly during measurement. The ‘heart’ symbol will blink with your pulse beat.
- If students wish to stop inflation at any time, they should press the exhaust valve to release the pressure in the cuff.
- After students see the measurement results displayed on the screen, they should press the exhaust valve to release the excess air from the cuff.
- If students move their arm before pressing the exhaust valve, the result on the screen will be deleted.
- The monitor shuts off automatically in about 30 seconds. Students can also press the START button (blue/grey button in the bottom right corner of the monitor) to shut off the monitor.
- Allow at least 5 minutes between measurements on the same student.