I’ve got the power
Lesson 2 (continued)

What happens to my heart rate and blood pressure when I exercise?

Aim
Students use the digital blood pressure monitor to measure their blood pressure and a pulse oximeter to measure their heart rate. They make their measurements at rest and immediately after two types of exercise (anaerobic then aerobic). They follow the cardiovascular system’s recovery from the different types of exercise. It is important that students coming to the experiment after one of the other carousel experiments allow their pulse and blood pressure to recover before measuring their resting blood pressure. They ought to rest for at least 5 minutes and preferably 15 minutes.

After making a prediction about how they expect their systolic blood pressure to change with anaerobic and aerobic exercise, they gather data to test their prediction. No student should feel under pressure to take part, for example if they are sensitive about their fitness or ability to do press-ups.

Equipment

<table>
<thead>
<tr>
<th>From the box</th>
<th>From your school</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 blood pressure monitor</td>
<td>stopclock</td>
</tr>
<tr>
<td>optional: 1 pulse oximeter</td>
<td></td>
</tr>
</tbody>
</table>

Safety

- If anyone begins the activity and starts to feel unwell they should stop immediately.
- Identify students with asthma so they can have their inhaler close at hand and use it if required.
- Identify any student (such as those with heart/lung problems) not able to take part in school PE/games lessons. They may need to be excused from taking part in the physical part of this activity but can take on a time-keeper or data recording role.
- If you have not used a blood pressure measuring instrument before, ask to be shown how to use one by an experienced colleague. Also refer to the ‘How to use the equipment in the box’ section on page 9 of this guide. The amount of inflation and the period of inflation must be carefully controlled. Students will need close supervision if using it themselves and any student with a known blood pressure or heart problem should not take part in the activity. Students should not measure their blood pressure more often than at 5 minute intervals.
- Ensure students carry out the activities in a suitable place, clear of any obstruction.
- Healthy competition is encouraged but be aware of and discourage excessive competition between students as it can lead to over-exertion and possible fainting or injury.

Running the experiment

1. Before the lesson, try out the blood pressure monitor and familiarise yourself with it. Students may need help with using it so that they ensure that the cuff is of the correct tightness around the arm and do not overinflate the cuff. It is most important that the air hose is in the correct position in the crook of the arm, where the artery is.
2 The measurement is complete when the buzzer sounds and the systolic and diastolic blood pressure readings and pulse rate are displayed. Sometimes during the test the blood pressure isn’t found and the Λ symbol is displayed. When this happens the cuff needs to be reinflated until the buzzer sounds.

3 In order to ensure that the blood pressure is measured as soon as the participant has finished the exercise, the student measuring the blood pressure needs to get the cuff on to the participant’s arm and inflated as quickly as possible. The participant could exercise with the cuff loosely in place and the air pipe tucked in, so at the end of the exercise period they just need to plug the air pipe into the monitor box. Care should be taken that this does not become loose and cause injury, as well as affecting the test by having to stop exercising to reposition the pipe or cuff.

4 Students will take pulse rate and blood pressure measurements at rest and after two different types of exercise: star jumps and press-ups. See the Student sheet on page 96 for the protocol for obtaining evidence. Note, it is easier to use the pulse oximeter to measure pulse rate every minute in the recovery period after exercise.

Expected results

Heart rate
Heart rate is likely to be between 160 and 170 beats per minute following the star jumps (aerobic exercise), rising to 180–190 beats per minute following the press-ups (anaerobic exercise). Resting heart rate is likely to be between 60 and 100 beats per minute, depending on the fitness of the individual and if they have consumed caffeine or smoked cigarettes. Recovery time for both pulse rate and blood pressure is usually around 10 minutes, but varies according to the individual’s fitness and degree of exertion.

The heart responds to the extra energy demands of the body with an increase in the rate of contraction (heart rate) and a rise in the volume of blood forced out of the heart during each ventricular contraction (stroke volume). The increase in heart rate and stroke volume causes the cardiac output to increase, allowing more oxygen to be carried to the muscles.

Blood pressure
Systolic pressure, the maximum pressure during a heart beat, is also likely to increase. Diastolic pressure, the minimum pressure during a heart beat, may not increase very much or may even fall during the lower intensity activity and may remain low following the exercise. A typical value for a young adult’s diastolic pressure before exercise is 70–80 mm Hg and after exercise is 70–80 mm Hg (the same). A typical value for systolic pressure before exercise is 100–120 mm Hg and after exercise is c.200 mm Hg. Both diastolic and systolic blood pressure increase with height and increase with smoking and amount of tension. Children and young people have higher blood pressure than adults.

Students should understand that the increase in systolic blood pressure during exercise occurs as a result of the increased force of contraction of the muscles pushing out more blood with each beat (stroke volume). The increase in stroke volume and heart rate and a potential decrease in resistance in the blood vessels allow more oxygen to get to the muscles that require it. During very high-intensity activity, the muscles also respire anaerobically as the extra oxygen demands of the muscles cannot be met. The high rate and force of contraction of the muscles can decrease the flow of the blood in the muscles and increase resistance in the blood vessels, resulting in an increase in diastolic blood pressure if enough muscles are contracting. During exercise, systolic blood pressure increases with sometimes an increase in diastolic blood pressure during very intense anaerobic exercise. After exercise, systolic and diastolic blood pressure both tend to fall rapidly, as both heart contractions and muscle contractions are no longer occurring.
Live Data Zone

Your students can enter their results from this experiment into the ‘Live Data Zone’ of the In the Zone website (www.getinthezone.org.uk); see the Teacher notes on page 99 for 16–19 Lesson 3.