

Brian Cox school experiments

What effect does exercise have on heart rate?

Your heart is a pump that circulates blood around your body. Oxygen from the air and glucose (sugar) from your food are taken to every cell in your body by your blood. The oxygen and glucose are needed by cells to release energy, this takes place through a process called respiration. If you are carrying out exercise your body respire more as the amount of energy your muscles need increases.

The heart rate is the number of times your heart beats per minute. When you exercise, the heart rate will increase, so blood can be pushed around the body faster, getting more oxygen and glucose to the muscles where it is needed to release energy.

This investigation asks students to work scientifically to measure the effect that exercise has on the heart rate. Students will think about how to investigate this, deciding what they will do and how they will measure this. They will look at their results and consider if they need to retest to get a more reliable result.

Introduction to Brian Cox school experiments

The Brian Cox school experiments are designed to support teachers to carry out experimental science in the classroom, and relate it to real world experiences. Creative and experimental approaches are particularly important for keeping students interested and engaged in science, and for equipping them well for the future, whether or not they pursue a career in science.

Each written resource is accompanied by four videos; two with extra information on how to carry out the experiment and two on how the experiment relates to the real world.

Learning outcomes

- Observe that exercise has the effect of raising the heart rate
- Set up simple practical enquiries
- Use measurements to draw conclusions
- Use straightforward scientific evidence to answer questions or to support findings

This experiment is based on a resource from [practicalbiology.org](https://www.practicalbiology.org) which was developed by the Nuffield Foundation and the Royal Society of Biology.

What effect does exercise have on heart rate?

Previous lessons may have already looked at observing the effects of exercise on the body, but this experiment asks students to find out what effect exercise has on the heart rate. Here they are using a measurement to see what the effect of exercise has on the heart rate.

Students measure their resting heart rate and then their heart rate after exercise. You could give them time to come up with a method for testing this themselves, perhaps in a previous class, or give them an exact method to follow.

Children will measure heart rate by taking their pulse. They could also use an oximeter, which may be purchased in many health and fitness stores or online.

It is advisable to check that children can find their own pulses before running the test. Your pulse can be found on your lower arm just below your wrist and may be felt by pressing your first two fingers lightly on this area. Many children press too hard or too lightly so cannot find a pulse at the first attempt. Remind students not to use their thumb to take their pulse, because thumbs have their own pulse and this can make it difficult to find. A pulse can also be found in your neck, halfway between your chin and your ear. This is shown in the second film.

Health and safety considerations:

- Be aware of any existing medical conditions, and ensure students are comfortable with what is asked of them. If students are known to have breathing difficulties such as asthma, you will need to monitor their activity levels.
- If running or carrying out exercise, children should wear appropriate footwear and clothing.
- Find an area, preferably outside where it is safe to carry out this activity, such as a playground or school hall.
- Ask children to do a warm up and a cool down before and after exercise as you would in a PE lesson.

Suggested sequence of events:

45/60 minutes

- Lead a class discussion to recall prior learning on the heart. Ask students what the heart does. Then ask them if they have ever noticed if their heart rate has increased. They can suggest times when this has happened. They may suggest after running, playing in the park, or a football match. Ask them what all these things are (exercise).
- Explain that today they are going to investigate how exercise affects the heart rate. If you are letting students come up with their own experiments than give them some time to do this now.

- Ask students what they will do in their investigation. Ask them what they will measure and how they will do this.
- Ask them what equipment they will need to carry out the experiment.
- Explain that they will need to work in pairs and take their resting pulse first. To do this they need to be sitting down calmly, because if they have been running around before this will alter their heart rate. One child will time 15 seconds, whilst the other takes their pulse. They will need to multiply this by 4 to get their heart rate over a minute. (This could also be done over 30 seconds and doubled).
- After the students take their resting pulse rates they decide on who will exercise first and agree how long the exercise will last for, or how many repeats to do. One or two minutes should be enough, or it could be 50 star jumps.
- One child in each pair carries out the chosen exercise for the time agreed, whilst the other person times the duration. When they finish the exercise, they take their pulse rate for 15 seconds, multiply it by 4 and record it in their table. They then swap over and carry out the experiment on the other member of the pair.
- Each pair looks at their results and sees if they think exercise has had an effect on the heart rate and what this was. They should try to explain why they think this is.
- If the whole class has carried out the same experiment then they could compare the data collected from the whole class. They will notice some variation in heart rates, but the trend should be the same. Explain that it is normal to expect some variation in heart rate within a group. The average resting heart rate of a healthy 10 year old child is 90 beats/min (ranging from 70 – 110 beats/min).
- If there are any results that are not similar to the others, students can repeat the experiment to see if the result was accurate. Tell them that scientists will carry out repeat experiments as this will lead to more reliable results. You may wish to ask all students to carry out the experiment twice more then take the average reading for their heart rate.

What effect does exercise have on heart rate?

Alternative experiments

- How does the type of exercise affect the heart rate?
- The procedure is the same as above, but each child will carry out three different types of exercise for a set amount of time. For this to be a fair test they should really test the different types of exercise on the same person for the same amount of time. It is important that students rest between each exercise, so they are always starting from their resting pulse.
- Pairs/groups could all be doing exactly the same amount of time and then they could compare the results as a class.

Extension

- Students could find out how long their heart rate takes to return to normal following exercise.
- They measure their pulse immediately after their exercise, then at 1 minute intervals, until it returns to normal resting heart rate. They plot this on a graph and explain what they can see from the graph. They could then investigate how long their heart takes to recover from different types of exercise.
- If using an oximeter then the heart rate can be measured every 10 seconds, as it can be attached to the child throughout the experiment. This can be recorded, until their heart rate has returned to normal. These results can be used to plot a line graph to show the change in heart rate over time during and after exercise.

Activity Toolbox

Resources

- Stopwatches/timers – 1 per pair of students
- PE Kits, suitable footwear for exercise
- Clipboards to hold recording sheets, or science books
- Pencils

Homework or cross-curricular activities

Find out heart rate after different activities at the weekend. Let children come up with their own ideas, but make sure they have the permission from their parents first. They could take their heart rate after swimming, football, dancing, walking or even tidying their bedroom!

They could predict which exercise raises heart rate the least, then try and find out.



ACTIVITY

Name Date

What effect does exercise have on heart rate?

Your heart is a pump which pushes blood around your body. Blood containing oxygen and glucose is pushed to all the cells in your body where it is used to keep you moving and growing. Your heart rate can be measured by taking your pulse, which is the push of the blood moving in your arteries. Heart rate is measured in beats per minute, (bpm). Do you think exercise will make your heart beat faster or slower?

Your task

Find out what effect exercise has on the heart rate.

You will need:

- Stopwatches/timers – 1 per pair of students
- PE Kits, suitable footwear for exercise
- Clipboards to hold recording sheets, or science books
- Pencils



ACTIVITY

You will need to work with a partner to carry out this experiment.

1. Check you can both find your own pulse, your teacher can help you to do this.
2. Measure your resting heart rate by taking your pulse. You will take this for 15 seconds then multiply this by 4 to get your heart rate. Your partner will tell you when to start and stop counting. Record your resting heart rate in the table. Your partner will also need to do this now.
3. Carry out your chosen exercise for a set amount of time, or number of repeats, eg 2 minutes of running on the spot or 50 star jumps.
4. Take your pulse as soon as you finish the exercise, your partner will tell you when to start and stop counting. You need to take your pulse for 15 seconds then multiply by 4 to get your heart rate after exercise.
5. Swap around, so your partner carries out steps 3 and 4.
6. If you have time carry out the experiment a second, or even third time. This helps check your results are accurate.



Results

Name	Heart rate before exercise (beats/minute)	Heart rate after exercise (beats/minute)

From my results I can see

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I conclude that

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