



# *Baylab: Heart Mechanics*



Teacher's Pack

## *Dear teachers,*

Welcome to Baylab, the free science laboratory for schools that supports teachers to deliver on the national curriculum for science, whilst encouraging students to get 'hands-on' in a state-of-the-art environment in a fun and engaging way.

Baylab has developed a new and exciting workshop focused on the cardiovascular system and wants to inspire the next generation of scientists by awakening an interest in cardiovascular health. We aim to do this by providing access to technology and equipment that may not be available in students' current education settings. As such, this comprehensive workshop will use novel teaching methods to help students understand the heart and cardiovascular system.

The workshop will last around 4 hours, starting at 9.30am and will cover:

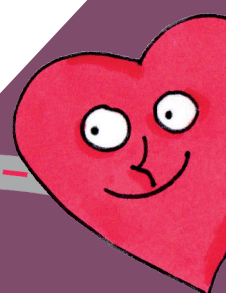
- The composition of blood
- The cardiovascular system
- The structure and function of the heart
- Heart disease
- Heart health and lifestyle

By the end of the workshop, students will have a good understanding of the core structures and function of the heart and cardiovascular system, heart diseases and their impact, and ways to look after their own hearts through healthier lifestyle choices. We want students to start thinking about the cardiovascular system in advance of attending Baylab, so we ask you to undertake some pre-workshop tasks with your class. Included in this pack are a cardiovascular quiz of interesting facts about the cardiovascular system. We would ask that you mark these in class and bring the results in on the workshop day (a percentage figure of how many got each question right or wrong will do).

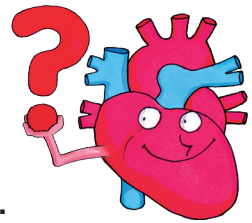
Baylab believes that the interest in learning about the cardiovascular system shouldn't stop after attending on the day. Following the workshop, we will provide details on how the students can enter a national Baylab competition, in which they have the chance to win science or sports equipment for your school!

We look forward to welcoming you and your class to Baylab.

*The Baylab Team*



# Heart, blood and circulatory system workshop quiz



Please complete me just for fun or prior to your Heart Mechanics workshop.

Name: ..... Score: ..... / 20

1. True or False, the blood cells travel to the lungs to receive oxygen.

☐ True ☐ False

2. True or False, there are around 5 billion red blood cells in 1ml of blood!

☐ True ☐ False

3. True or False, red blood cells live for 60 days.

☐ True ☐ False

4. True or False, if you spread out all the blood vessels in your body into one long line they would reach out to a length of 6,000 miles!

☐ True ☐ False

5. True or False, red blood cells are made in the bone marrow and take about 5 days to be created.

☐ True ☐ False

6. True or False, laughing is good for your heart by reducing inflammation.

☐ True ☐ False

7. True or False, most of the gold in our body is found in the blood.

☐ True ☐ False

8. True or False, over a lifetime, the heart produces enough energy to drive to Mars and back.

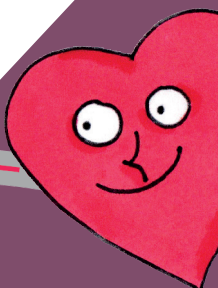
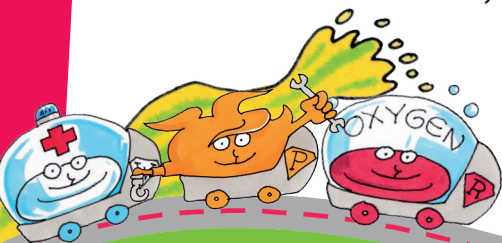
☐ True ☐ False

9. True or False, the fairy fly has the smallest heart of any living creature.

☐ True ☐ False

10. True or False, a whale's heart is twice the size of a car.

☐ True ☐ False





11. True or False, the thumping sound from the heart is from the opening and closing of the valves inside the heart.

☐ True ☐ False

12. True or False, there are 3 types of blood vessel and capillaries are the smallest.

☐ True ☐ False

13. True or False, all fat is bad for your heart.

☐ True ☐ False

14. True or False, it takes about 4 months for all of your blood to be replaced with new blood.

☐ True ☐ False

15. True or False, it takes one minute for blood to travel around the system once.

☐ True ☐ False

16. True or False, leafy green vegetables contain vitamin K which helps blood to clot properly.

☐ True ☐ False

17. True or False, berries contain vitamins that help to prevent blockages with the blood vessels.

☐ True ☐ False

18. True or False, fatty fish and fish oil contain omega-2 fatty acids.

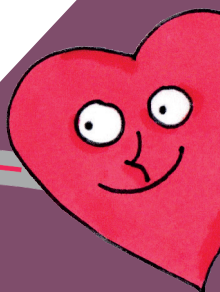
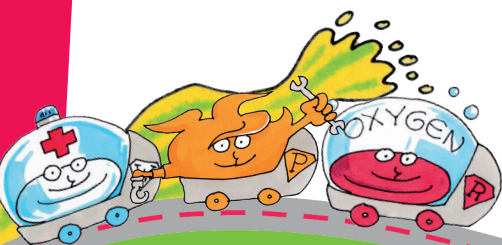
☐ True ☐ False

19. True or False, studies have shown that eating lots of tomatoes is good for your heart.

☐ True ☐ False

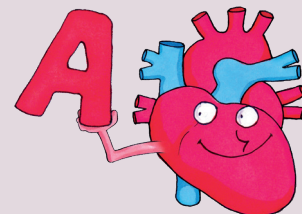
20. True or False, dark chocolate contains the antioxidants known as flavonoids which is bad for your heart.

☐ True ☐ False





# Heart, blood and circulatory system workshop quiz answers



1. **True** or False, the blood cells travel to the lungs to receive oxygen.

**Explanation:** Blood does go to the lungs to collect oxygen and deposit carbon dioxide. You breathe oxygen in and carbon dioxide out.

2. **True** or False, there are around 5 billion red blood cells in 1 ml of blood!

**Explanation:** You may know that in  $1\text{mm}^3$  there are 5 million red blood cells. So to get to 1 ml of blood you multiply it by 1000. This gets us to 5 billion red blood cells.

3. True or **False**, red blood cells live for 60 days.

**Explanation:** Red blood cells actually live for twice that long, that's 120 days!

4. True or **False**, if you spread out all the blood vessels in your body into one long line they would reach out to a length of 6,000 miles!

**Explanation:** In fact if you spread them out into a line it would actually reach up to 60,000 miles. In comparison the circumference of the Earth (A line going all the way around the outside) is only 25,000 miles.

5. True or **False**, red blood cells are made in the bone marrow and take about 5 days to be created.

**Explanation:** Red blood cells only take 2 days to be made. However the body makes many at once, around 2 million every second! However the red blood cells are still made in the bone marrow.

6. **True** or False, laughing is good for your heart by reducing inflammation.

**Explanation:** This is because laughing reduces inflammation markers and removes cholesterol and other chemicals.

7. **True** or False, most of the gold in our body is found in the blood.

**Explanation:** The body has about 0.2mg of gold and most of that is in our blood. But don't bother trying to get that gold because it would take 5,000 people's worth of gold to get 1 gram of gold worth £27.75.

8. True or **False**, over a lifetime, the heart produces enough energy to drive to Mars and back.

**Explanation:** The heart does not produce quite that much energy, however it does produce enough to drive to the moon and back. For some context the distance to Mars and back is 467.8 million miles and the distance to the moon and back it 477,710 miles.

9. **True** or False, the fairy fly has the smallest heart of any living creature.

**Explanation:** The fairy fly's heart beats over 300 times per minute. However it does not have the highest heart beat per minute. Shrews' hearts beat at 1000 times per minute and the humming bird's heart beats at 1400 times per minute. That's over 23 beats every second.

10. True of **False**, a whale's heart is twice the size of a car.

**Explanation:** A whale's heart on average is only the size of one slightly compacted car. The whales' heart beat is only at 6bpm. On the other hand it is not the slowest heart beat. The wood frog's heart beat can completely STOP! over the winter and then restart once it gets warmer.



11. **True** or False, the thumping sound from the heart is from the opening and closing of the valves inside the heart.

**Explanation:** The valves open and close with enough force and pressure to suck blood into different parts of the heart as well as through the blood vessels. This creates the thump you can hear.

12. **True** or False, there are 3 types of blood vessel and capillaries are the smallest.

**Explanation:** Capillaries connect the arteries to the veins, the other two blood vessels. However because of how small they are, the red blood cells must go through them in single file.

13. True or **False**, all fat is bad for your heart.

**Explanation:** Not all fat is bad for your heart. It is needed to keep you warm. However too much fat can cause clogging in your arteries and veins.

14. **True** or False, it takes about 4 months for all of your blood to be replaced with new blood.

**Explanation:** All of the blood in your body is replaced every 4 months. Don't worry though, it is replaced as soon as it dies.

15. True or **False**, it takes one minute for blood to travel around the system once.

**Explanation:** It actually only takes 20 seconds. That means it goes around your body three times every minute.

16. **True** or False, leafy green vegetables contain vitamin K which helps blood to clot properly.

**Explanation:** Vitamin K is used by the body to protect the arteries to promote the blood to clot properly and not block the arteries which could result in a stroke.

17. True or **False**, berries contain vitamins that help to prevent blockages with the blood vessels.

**Explanation:** Berries actually contain antioxidants that which help to prevent oxidative stress and inflammation.

18. True or **False**, fatty fish and fish oil contain omega-2 fatty acids.

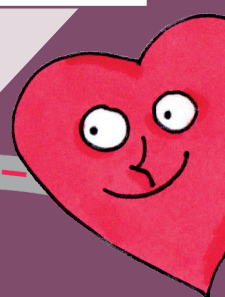
**Explanation:** Fatty fish and fish oil contain omega-3 fatty acids. This can help to reduce diastolic blood pressure. Diastolic blood pressure is the pressure on the heart in between beats.

19. **True** or False, studies have shown that eating lots of tomatoes is good for your heart.

**Explanation:** Tomatoes are rich in lycopene and have been associated with a lower risk of heart disease and stroke, as well as an increase in "good" HDL cholesterol.

20. True or **False**, dark chocolate contains the antioxidants known as flavonoids which is bad for your heart.

**Explanation:** Eating dark chocolate several times per week can reduce the risk of coronary heart disease because of these antioxidants.



# Heart mechanics cardiovascular health word search

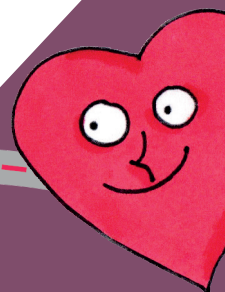
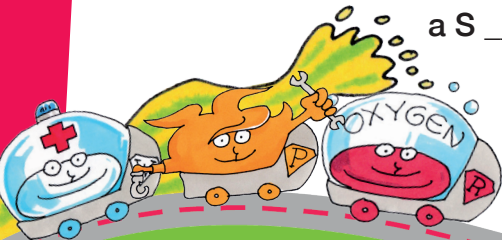
This can be completed as a standalone resource or as a summary of the workshop.

Name: ..... Score: ..... / 24



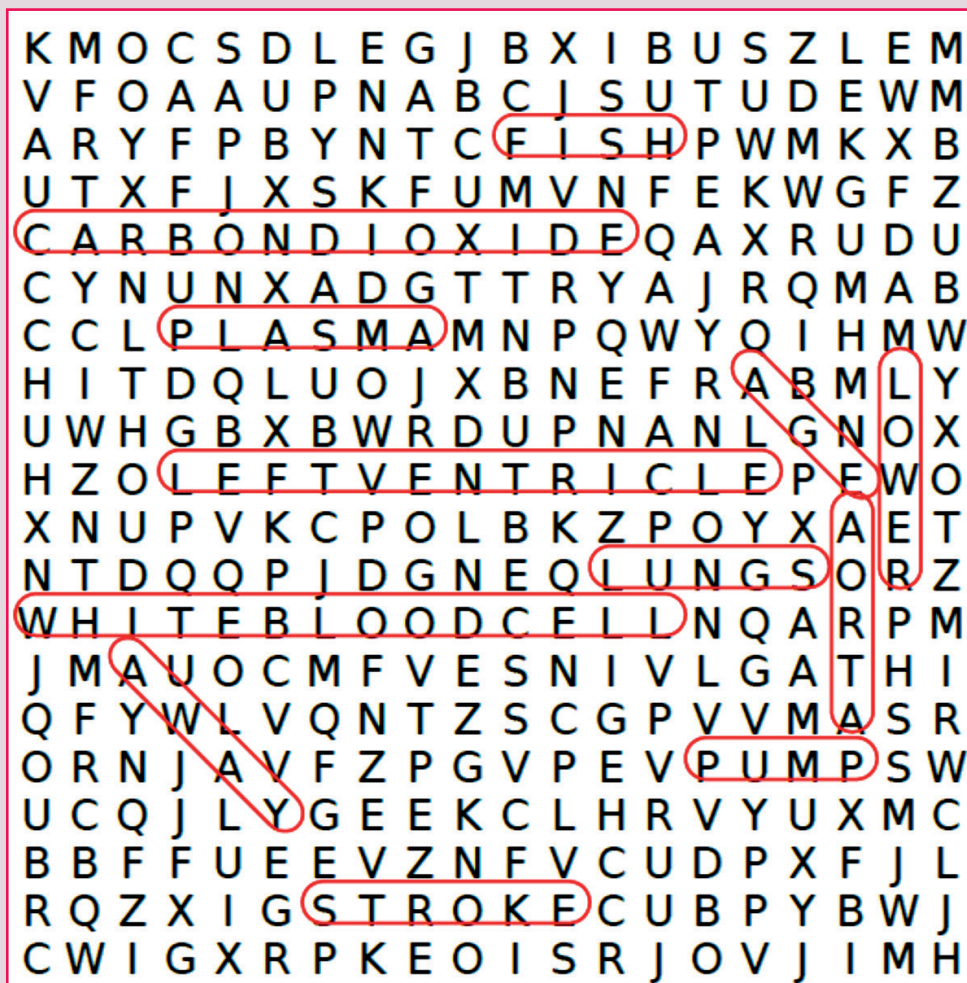
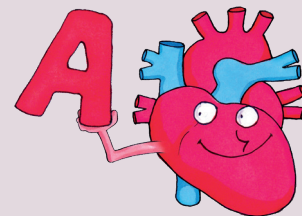
Answer the questions or clues below and find the answers in the word search above. You will get 1 point for each correct answer and for each word found. Maximum of 24 points.

1. Where does blood go to become oxygenated? \_\_\_\_\_
2. Do the arteries take blood towards or away from the heart? \_\_\_\_\_
3. The heart's job is to p \_\_\_\_\_ blood around the body.
4. After entering the left atrium, where does the blood go? \_\_\_\_\_
5. What type of blood cell kills bacteria? \_\_\_\_\_
6. Apart from blood cells and platelets, what is in our blood? P \_\_\_\_\_
7. Maximum heart rate can be calculated as 220 – your \_\_\_\_\_
8. Would an athlete have a higher or lower resting heart rate? \_\_\_\_\_
9. The largest artery in the human body is called the A \_\_\_\_\_
10. What is the waste gas received when giving oxygen to the muscles? \_\_\_\_\_
11. F \_\_\_\_\_ is one of the best sources of the fatty acids that are good for your heart.
12. Eating healthily, exercising, not smoking, not drinking large amounts of alcohol and controlling blood pressure are good ways to prevent having a S \_\_\_\_\_



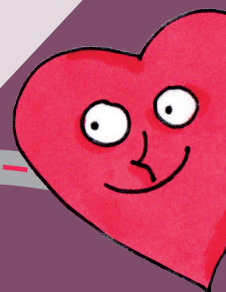
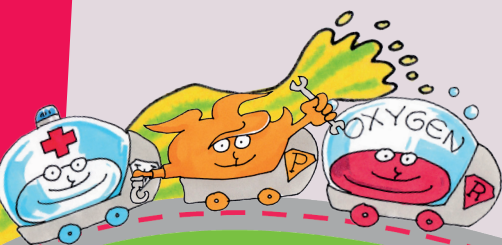


# Heart mechanics cardiovascular health word search answers



Answer the questions or clues below and find the answers in the word search above. You will get 1 point for each correct answer and for each word found. Maximum of 24 points.

- Where does blood go to become oxygenated? **Lungs**
- Do the arteries take blood towards or away from the heart? **Away**
- The heart's job is to **pump** blood around the body.
- After entering the left atrium, where does the blood go? **Left Ventricle**
- What type of blood cell kills bacteria? **White blood cell**
- Apart from blood cells and platelets, what is in our blood? **Plasma**
- Maximum heart rate can be calculated as  $220 - \text{your age}$ .
- Would an athlete have a higher or lower resting heart rate? **Lower**
- The largest artery in the human body is called the **Aorta**.
- What is the waste gas received when giving oxygen to the muscles? **Carbon Dioxide**
- Fish** is one of the best sources of the fatty acids that are good for your heart.
- Eating healthily, exercising, not smoking, not drinking large amounts of alcohol and controlling blood pressure are good ways to prevent having a **Stroke**.



## WHAT YOU WILL NEED

- 2 Balloons



- Scissors



- 3 Jars



- Tape



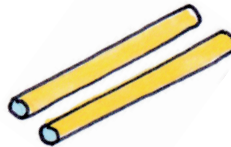
- Water



- 5 drops of red food dye



- Straight Straws



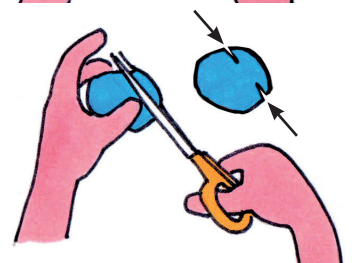
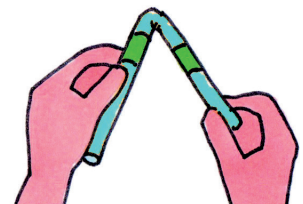
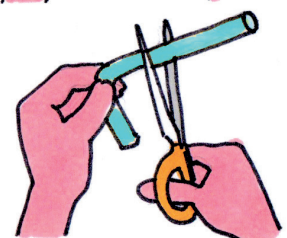
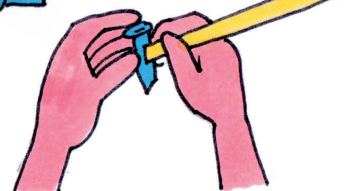
- 1 Bendy Straw



## METHOD

**Grab all of your equipment before starting**

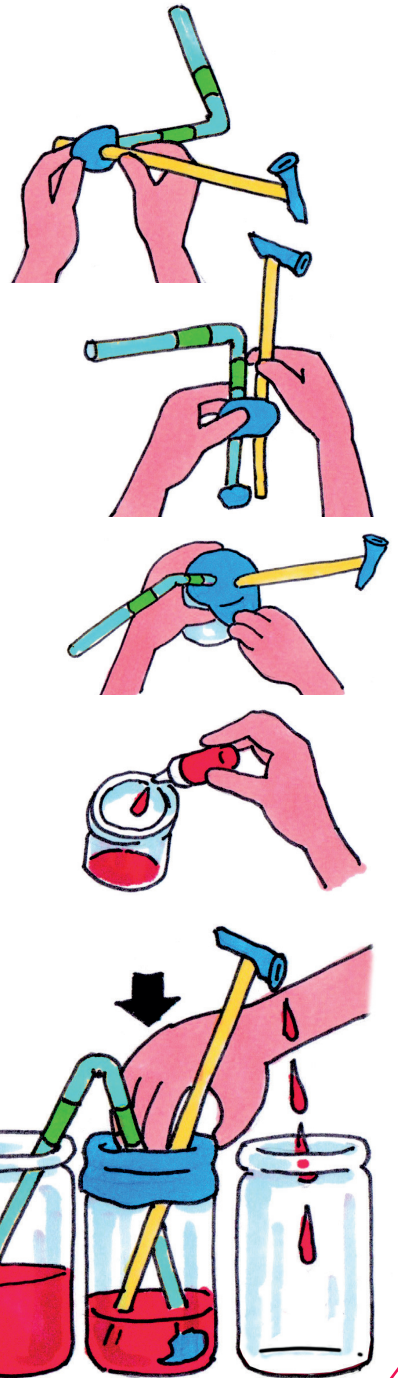
- 1 Cut the necks off the balloons.  
Then tape the cut end of the balloons closed
- 2 Cut a tiny slit (enough to fit the straw into, should be a tight fit) into each of the balloon necks about half an inch below the tape.  
Next insert a straight straw into one of the balloons.  
Set the other aside for now.
- 3 Cut the bendy straw so that there is 1 and a half inches on either side of the bend. Then cut the other straight straw into two halves, as close to equal as possible.
- 4 Tape the bendy straw in between the two half-length straws.
- 5 Cut two small slits directly across from one another near the top of the balloon tops.



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## METHOD

- 6 Insert the long straw and the bendy straw into the two slits. The balloon neck on the long straw should be above the rest of the balloon.
- 7 Insert the balloon set aside in step 2 onto the half-length straw on the opposite side of the long straw.
- 8 Stretch the balloon over the top of one of the jars. The balloon neck on the bendy straw should be inside the jar and the balloon neck on the straight straw should be outside of the jar.
- 9 Fill one of the jars about three quarters full with water. Then drip about 5 drops of red food colouring into the water.
- 10 Place the jar filled with water on the other end of the bendy straw and the empty jar underneath the other straw. Press down on the stretched balloon and see what happens.

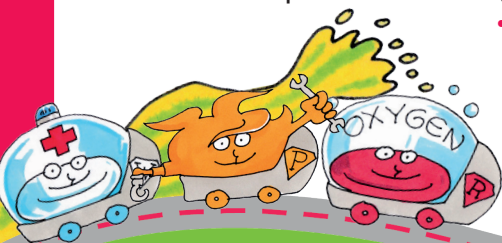


*How do you think this could represent the right side of the heart?*

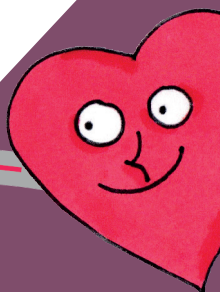
Why not send your pictures to Twitter and Instagram  
[@bayerbaylab](#), [#Baylab](#) or Twitter [@ukbayer](#)

## FUN FACTS

- The heart beats around 100,000 times every day
- The heart produces enough energy in a day to drive a truck 20 miles
  - The heart pumps 2160 gallons of blood every day.

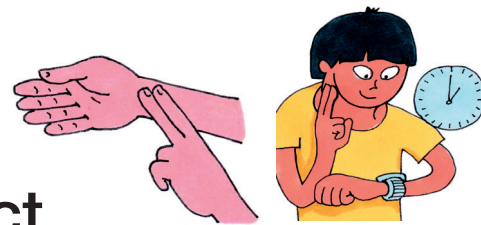


This experiment shows the right ventricle receiving deoxygenated blood from the right atrium through the tricuspid valve and then pumping it into the body through the pulmonary valve.





## Teacher instructions:



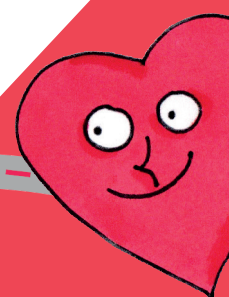
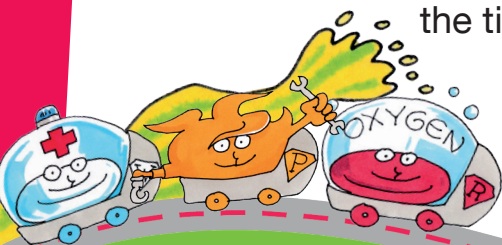
# How does your exercise affect your heart rate?

1. Before starting the experiment all participants must be able to take their pulse. Practice this with them first.
2. Show students how to calculate the change in heart rate using examples.
3. Students then need to pick their exercise; this could simply be walking, running, hopping, star jumps, press-ups, anything they'd like.
4. Talk about the importance of making predictions in Science. Students then predict which exercise will change their heart rate the most. Can they explain why?
5. In every science experiment there are variables, factors they change (in this case exercise), factors they measure (in this case heart rate) and factors they need to control to ensure it's a fair test (such as time taken on each exercise, time of rest between exercises, same person doing exercises). Discuss the different variables as a group and decide on things you will keep the same. We recommend at least 1 minute of exercise to see a change with 3 minutes minimum rest.
6. Students carry out each exercise
7. Encourage students to repeat each exercise once, talk about why we do repeats but also why in this case it may not be fair?
8. Share results with the class and write conclusions



As a bonus challenge, try to encourage students to use their science knowledge to explain why heart rate increases with exercise and why resting will decrease heart rate.

For schools who didn't attend the heart workshop at the Baylab, why not pick one exercise and investigate another variable for example How does the time spent exercising affect heart rate?



## Activity:

# Keeping the heart healthy

## How does your exercise affect your heart rate?



In this experiment, we hope to find out how your heart rate changes during different types of exercise.

*To measure your heart rate you will need to find your pulse. To do this:*

1. Place two fingers on your wrist with your palm facing up
2. Slowly move your fingers around your wrist until you feel a faint beating. This is your pulse.
3. Count how many beats you feel for 10 seconds then multiply that number by 6 to get your heart rate.
4. If you cannot find your pulse on your wrist, ask for help or try to find it on your neck.

Choose 3 types of exercise; for example walking, running on the spot, star jumps, running up and down stairs etc

Exercise 1:

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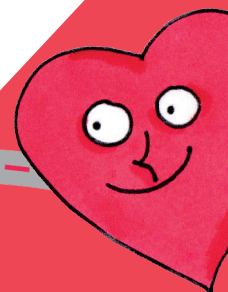
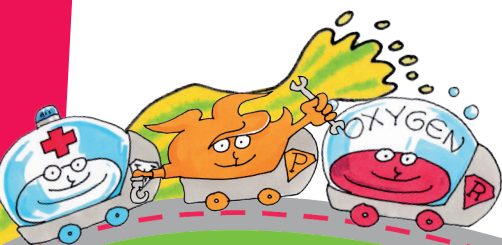
Exercise 2:

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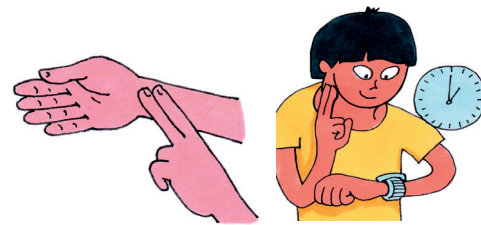
Exercise 3:

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# How does your exercise affect your heart rate?



Can you predict which type of exercise you think will raise heart rate the most?

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If we are changing the type of exercise, which variables should stay the same in order to make this a fair test?

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.....

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## Results:

Type of exercise	Exercise 1	Exercise 2	Exercise 3
Heart rate before exercise (bpm)			
Heart rate after exercise (bpm)			
Increase in heart rate (bpm)			

**Conclusion:** Which heart rate increased your heart rate the most?

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Why does heart rate increase with exercise?

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