- Respiration

SPECIAL

ARE YOU BREATHING PROPERLY?



Whether you're running a marathon or just relaxing, there are ways of breathing more efficiently for better health and performance

WORDS AILSA HARVEY

The average adult breathes in 7,570 litres of air daily – the equivalent of filling up 45 regular bathtubs. Of this volume, only 20 per cent is life-sustaining oxygen, and 15 per cent of this inhaled oxygen leaves the body again during exhalation. That means only around 378 litres of the total inhaled air is used to oxygenate the body. Every cell in your body depends on oxygen to produce energy and keep you alive. After this oxygen is consumed, carbon dioxide gas is exhaled as a waste product.

Healthy breathing should be effortless and quiet. So effortless that most of the time you don't even notice the constant rise and fall of your chest – except for the attention you're probably paying right now. However, there are some situations that change your breathing ability, or how noisy it is. This includes heightened physical activity, which increases the demand for oxygen. Your body has to start pumping blood faster and breathing at a quicker rate to keep up with your oxygen consumption. Challenging the respiratory system in this way strengthens it over time.

Did you know?

Five per cent of inhaled air is absorbed into the blood

DID YOU KNOW? Inhaled air comprises 0.004 per cent carbon dioxide and exhaled air 4.4 per cent



The weather also holds some power over your ability to breathe. Hot and humid air can cause airway inflammation, while warmer seasons come with extra air pollutants like pollen. Cold and dry air can also be problematic by drying out the airways, causing coughing and wheezing. Other breathing struggles are due to internal factors. When you become scared or severely stressed, your brain can launch the fight-or-flight response, increasing your heart rate. This causes faster breathing and often leads to breathlessness.

The core mechanism of breathing is subconscious, but during breathing difficulties you can make active changes to posture, breathing rhythm and depth of breath to increase oxygen efficiency. Short breathing exercises train your body to better utilise air. But before beginning regular breathing exercises, you should speak with a health professional. Changing your breathing pattern away from your subconscious rhythm affects individuals differently, especially those with underlying health conditions.

"Only around 378 litres of the total inhaled air is used to oxygenate the body"



Trees pump out oxygen as a waste product

With over 8 billion people sucking up the atmosphere's oxygen, how is there still enough left to breathe? To keep air concentrations balanced, we breathe in collaboration with green plants. These plants use sunlight and carbon dioxide in a process called photosynthesis to give them energy, releasing oxygen as a waste product. That's why a breath of air in a forest contains more oxygen than the same volume of air in an urban area.

DO YOU NEED MORE OXYGEN?

Certain conditions and environments can prevent you from inhaling or absorbing enough oxygen. Some of the signs your body makes to indicate you aren't breathing properly include an increased breathing rate, frequent sighing, wheezing, grunting or nose flaring. Your breathing rate is the number of breaths you take per minute and an increase in this is often your body's attempt to increase oxygen intake.

Sighing helps increase oxygen levels with a strong exhale. As the air is forced out of the lungs, the collapsed alveoli are able to take in twice as much air in the following breath. For those suffering from inflamed and tight air passages, breathing might be paired with wheezing. This noise is caused by narrow airways making it difficult for enough air to pass through. Alternatively, a grunting noise heard when you exhale is the body attempting to keep the lungs filled with air for longer. Other signs are more subtle, such as nose flaring during breathing. By widening the opening to the nose, more air can enter the body.



A normal breathing rate for adults is between 12 and 25 breaths per minute at rest

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SPECIAL

EXPANDING LUNGS

Oxygen diffuses into the body via these six-litre chambers



INSPIRATION

Did you know?
Your left lung is slightly smaller than the right

4 AIR INTAKE
The increased space in the chest cavity causes oxygen-rich air to be sucked into the nose or mouth and into the lungs.

5 AIR SAC ABSORPTION
Air travels into air sacs in the lungs called alveoli. Oxygen is absorbed through the membranes and into the surrounding blood vessels.

6 RELAXATION
When you breathe out, the diaphragm and rib muscles relax and the lung space decreases again.

2 INCREASED SPACE
As the diaphragm moves downwards, there's more space in the chest for the lungs to expand.

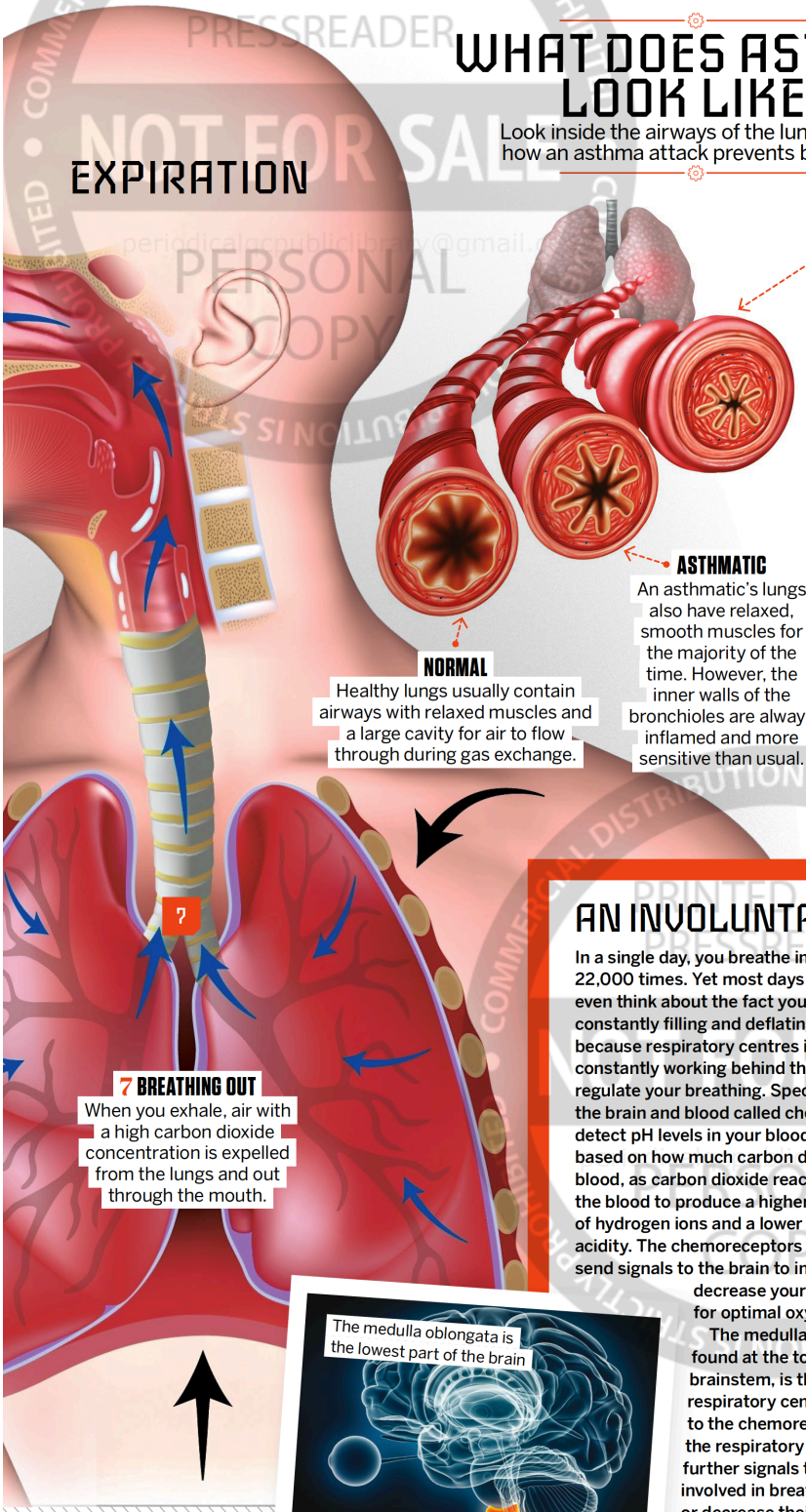
3 TIGHTENING MUSCLES
The muscles between your ribs contract to pull the ribs upwards and outwards.

1 DIAPHRAGM CONTRACTION
When you breathe in, the large, dome-shaped muscle called the diaphragm contracts and moves downwards.

DID YOU KNOW? 99 per cent of the population breathes air with pollutants exceeding the World Health Organization's air-quality limits

WHAT DOES ASTHMA LOOK LIKE?

Look inside the airways of the lungs to see how an asthma attack prevents breathing



AN INVOLUNTARY ACT

In a single day, you breathe in and out about 22,000 times. Yet most days you might not even think about the fact your lungs are constantly filling and deflating. This is because respiratory centres in the brain are constantly working behind the scenes to regulate your breathing. Special nerve cells in the brain and blood called chemoreceptors detect pH levels in your blood. This changes based on how much carbon dioxide is in the blood, as carbon dioxide reacts with water in the blood to produce a higher concentration of hydrogen ions and a lower pH, or higher acidity. The chemoreceptors track this and send signals to the brain to increase and decrease your breathing rate for optimal oxygenation.

The medulla oblongata, found at the top of the brainstem, is the main respiratory centre. In response to the chemoreceptors' signals, the respiratory centre sends further signals to the muscles involved in breathing to increase or decrease their movement rate and alter the oxygenation of your blood.

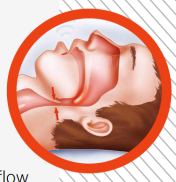
5 FACTS RESPIRATORY CONDITIONS



1 ASTHMA
300 million people have asthma – a condition caused by the narrowing and swelling of lung airways and excessive mucus production. During asthma attacks, airway muscles constrict, causing wheezing and breathlessness.



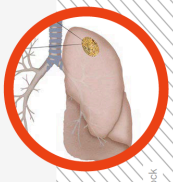
2 COPD
Chronic obstructive pulmonary disease (COPD) is a group of lung conditions including emphysema (damage to the lungs' air sacs) and bronchitis (airway inflammation). Most sufferers are older adults who smoke.



3 SLEEP APNEA
This disorder is defined by intermittent breathing when sleeping. This can be caused by the throat muscles blocking airflow or a reduction in signals from the brain to breathing muscles.



4 PNEUMONIA
Pneumonia is a bacterial or viral infection leading to inflammation in the air sacs of one or both lungs. As a result, the alveoli become filled with fluid, obstructing breathing.



5 ASBESTOSIS
This is caused by long-term exposure to asbestos fibres – a natural mineral previously used as building insulation. Inhaling asbestos scars lung tissue, limiting breathing or producing a crackling sound with breaths.

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SPECIAL

BENEFICIAL BREATH



Deep breathing exercises are best done with a straight back so that the lungs have space to fully expand

STRESS RELIEF AND ANTI-ANXIETY

Controlling your breathing patterns can help in certain situations. Box breathing slows down your breathing and can be a relief in stressful circumstances. First, inhale deeply for four seconds, then hold your breath for four seconds before exhaling for four seconds and holding the breath once more. This can be repeated to calm the nervous system and return breathing to its normal rhythm. Box breathing is named because of the four repeated elements. You can draw a box in the air with your finger while carrying out this breathing exercise to keep the mind focused on the slow rhythm. US Navy SEALs use this technique in stressful situations, enabling them to think clearly.

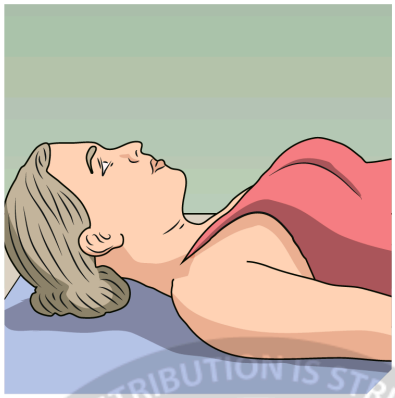
4-7-8 breathing is a similar exercise that involves holding your breath for longer at a time and can help reduce anxiety. People often resort to this technique if they are unable to fall asleep. It involves breathing in through the nose for four seconds, holding that breath for seven seconds and forcefully breathing out through the mouth for eight seconds. At first this breathing exercise can make you feel light-headed, so it shouldn't be repeated more than four times. Even after practising, it's recommended that you don't repeat the cycle more than eight times consecutively.

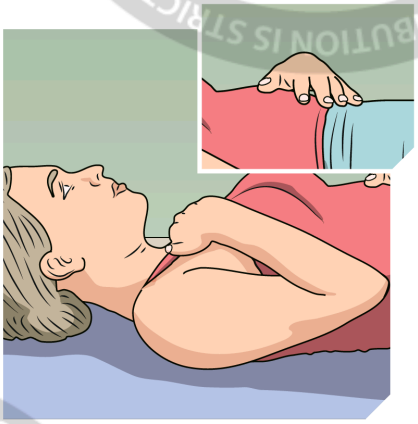
Did you know?

There are 1,490 miles of airways in the lungs

DIAPHRAGMATIC BREATHING

This deep inhale-exhale technique lowers your heart rate and blood pressure

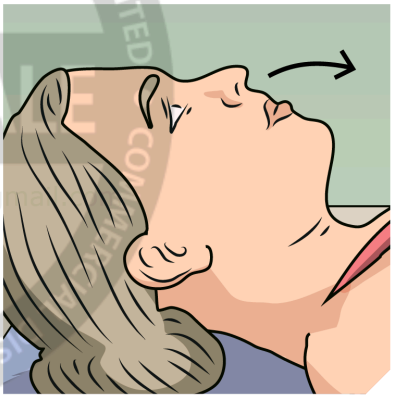




1 FIND A COMFORTABLE POSITION
Sit or lie down somewhere comfortable. You may also want to close your eyes to remove all distractions.

2 PLACE YOUR HANDS
Put one hand on your chest and the other on your abdomen. Try to control your breathing so that during inhalation and exhalation only your bottom hand is moving.





3 INHALE FOR FOUR
Breathe in through your nose and focus on breathing deeply so that your abdomen expands. Count to four while inhaling before holding your breath for two seconds.

4 RELEASE BREATH
Exhale through your mouth for about six seconds while keeping your mouth relaxed. Continue this breathing pattern for between 5 and 15 minutes.

DID YOU KNOW? When at rest, your body loses around 17.5 millilitres of water an hour in your exhaled breath

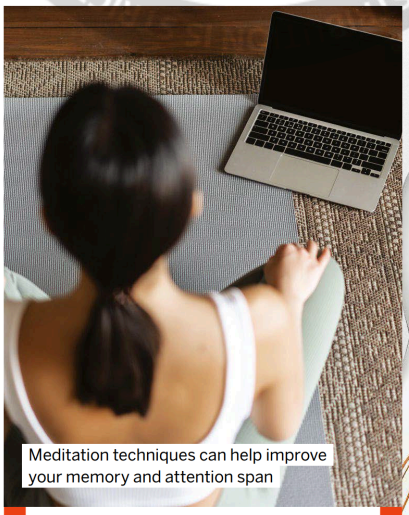
PREVENTING PAIN

How controlled breathing can serve as a natural anaesthetic

1 PARASYMPATHETIC NERVOUS SYSTEM
Breathing activates this part of the nervous system, responsible for relaxing the body and calming pain signals.

2 MUSCLE RELAXATION
When breathing, muscle tension is reduced, relieving any muscle pain.

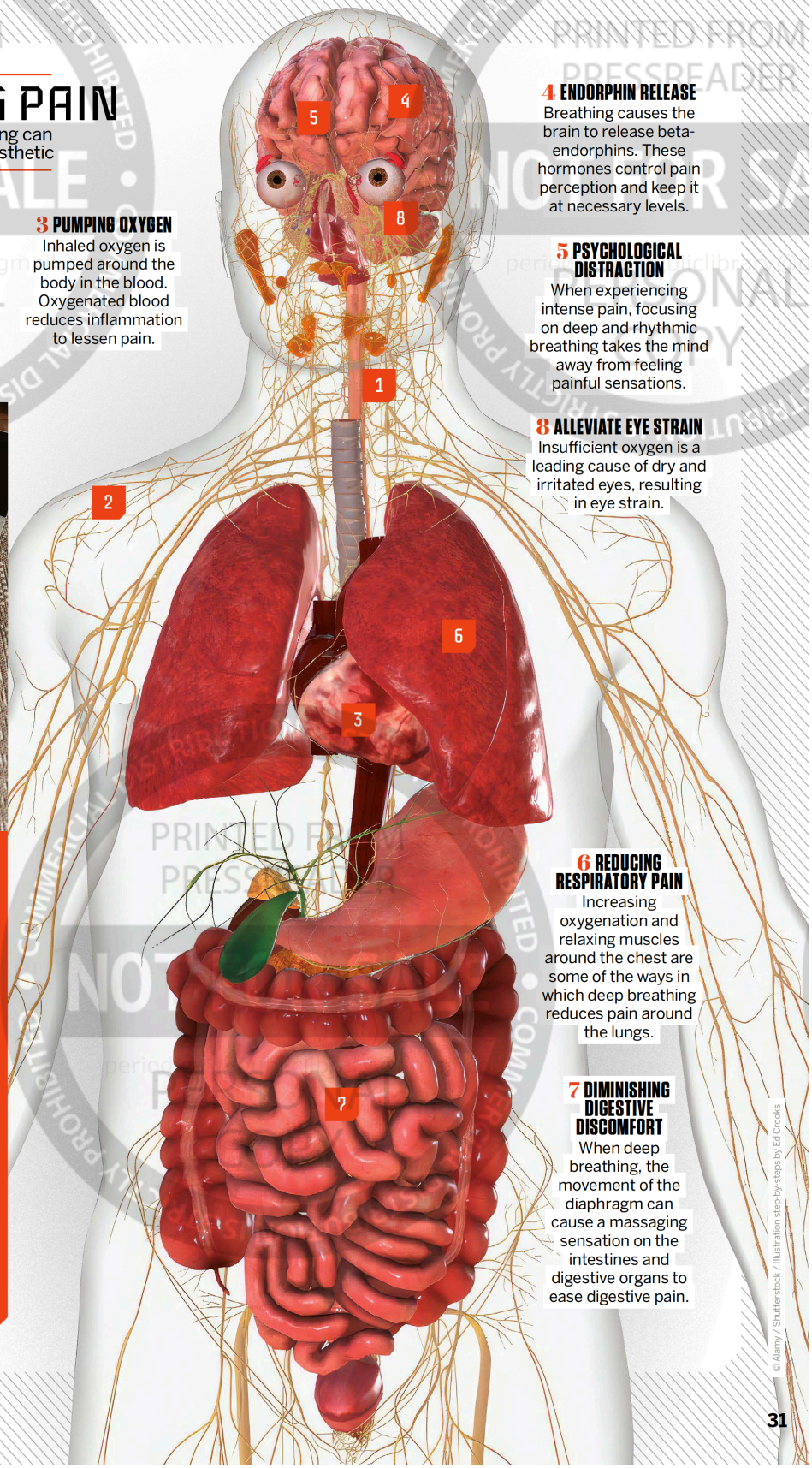
3 PUMPING OXYGEN
Inhaled oxygen is pumped around the body in the blood. Oxygenated blood reduces inflammation to lessen pain.



Meditation techniques can help improve your memory and attention span

MINDFULNESS

Meditation is the practice of training the mind to achieve clear, stress-free thoughts and full-body relaxation. To achieve this, controlled breathing is a key factor. Mindfulness is the technique of focusing on the body's sensations, including any thoughts that crop up and the flow of breath. Studies have shown that engaging in mindful breathing activities like meditation can increase your focus and reduce anxiety, depression and distress. In 2016, scientists at Haverford College in Pennsylvania found that those who practised mindful breathing before a given task made fewer mistakes than those who didn't. This technique has also been shown to reduce test anxiety and reduce post-traumatic stress disorder (PTSD) symptoms.



4 ENDORPHIN RELEASE
Breathing causes the brain to release beta-endorphins. These hormones control pain perception and keep it at necessary levels.

5 PSYCHOLOGICAL DISTRACTION
When experiencing intense pain, focusing on deep and rhythmic breathing takes the mind away from feeling painful sensations.

8 ALLEVIATE EYE STRAIN
Insufficient oxygen is a leading cause of dry and irritated eyes, resulting in eye strain.

6 REDUCING RESPIRATORY PAIN
Increasing oxygenation and relaxing muscles around the chest are some of the ways in which deep breathing reduces pain around the lungs.

7 DIMINISHING DIGESTIVE DISCOMFORT
When deep breathing, the movement of the diaphragm can cause a massaging sensation on the intestines and digestive organs to ease digestive pain.

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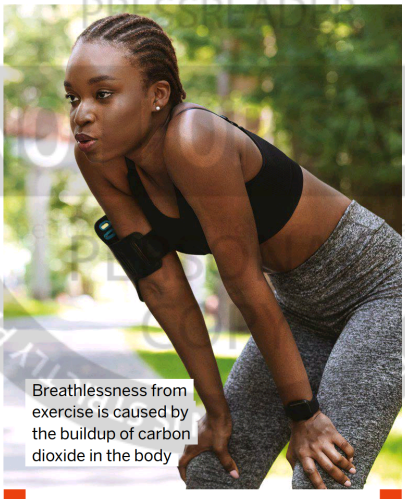


Breathlessness from exercise is caused by the buildup of carbon dioxide in the body

OXYGEN CONSUMPTION DURING CARDIO

Unlike strength training, aerobic or cardiovascular training tests the respiratory and cardiovascular systems by increasing your body's demand for oxygen over a longer period of time. To maximise oxygen uptake and carbon dioxide removal from the blood and lungs when running, swimming, cycling or taking part in other aerobic activities, you should breathe in through your nose and release air through the mouth. This helps filter and humidify inhaled air by trapping small particles in your nose hairs and preventing them from entering the lungs. The nasal passage is surrounded by blood vessels that warm and moisten the air as it passes through the nose. This aids your breathing during physical exercise by preventing airways from drying out. In contrast, exhaling through the mouth is more efficient as it helps expel carbon-dioxide-rich air quickly before the next intake of breath. How much oxygen your body can use during exercise varies between individuals and is quantified as your VO_2 max level. By pushing your limits and exercising close to your maximum heart rate, you can increase your VO_2 level and make each breath efficient.

KEEP IT RHYTHMIC

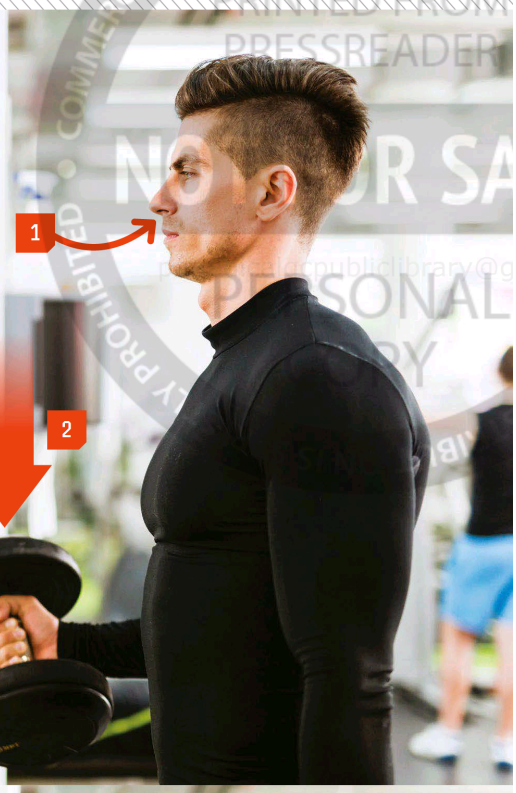
When is the right time to breathe during strength training for maximum efficiency?

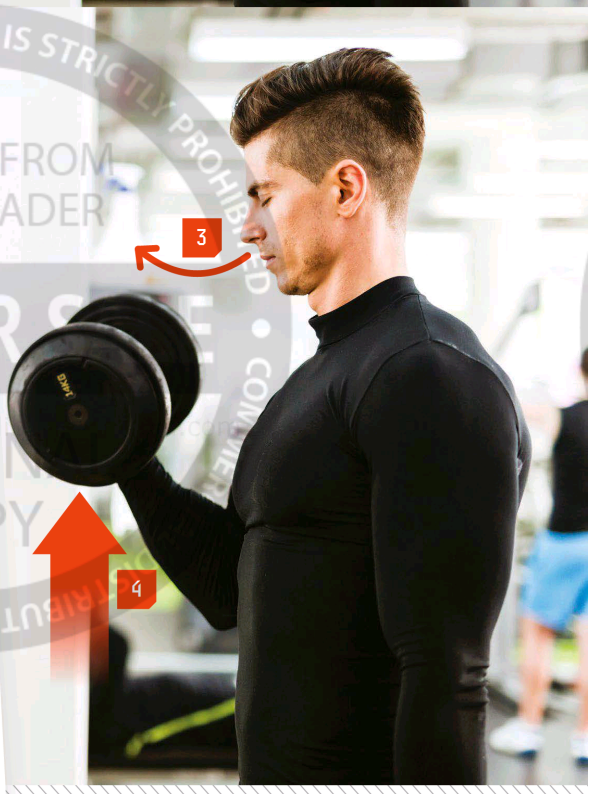
1 INHALE AND LOWER
During muscle-lengthening actions like lowering the weight, inhale through the nose to engage the diaphragm.

2 CONTROLLED MOVEMENT
The controlled action of lowering the weight matches the increased time taken to inhale and fill the lungs.

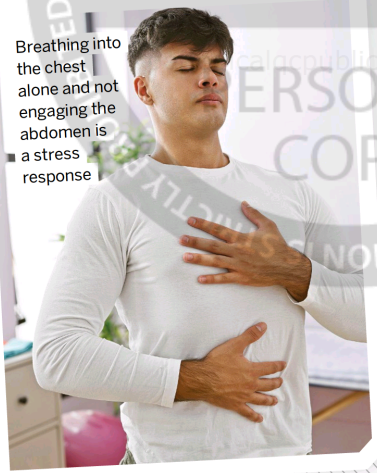
3 EXHALE AND LIFT
Breathe out through the mouth to expel air quickly. This helps release the pressure built up in the tense chest and abdomen muscles to increase stability.

4 RESISTANCE LIFT
The muscle movement requiring the most physical effort often takes the least time. Don't be tempted to hold your breath, as this increases the strain on the body.





Did you know?
The lungs have 300 to 500 million air sacs



Breathing into the chest alone and not engaging the abdomen is a stress response

DID YOU KNOW? Between the 1930s and 1950s, it was thought that asthma was a psychological condition

PRACTISE PURSED-LIP BREATHING

How changing your mouth's position can better remove air from the lungs

PURSED-LIP BREATHING

1 PURSED LIPS
Breathing out with pursed or puckered lips produces a narrow escape for air. Some escapes, while some is blocked by the lips and pushed back into the mouth to create back pressure.

2 OPEN AIRWAYS
The back pressure keeps airways open for longer and provides more time for air to escape the lungs' air sacs. This is especially useful for people who suffer from blocked or damaged airways.

3 HEALTHY BLOOD VESSELS
Slowing exhalation down means that more oxygen is absorbed into the blood. The blood vessels are healthy and dilated.

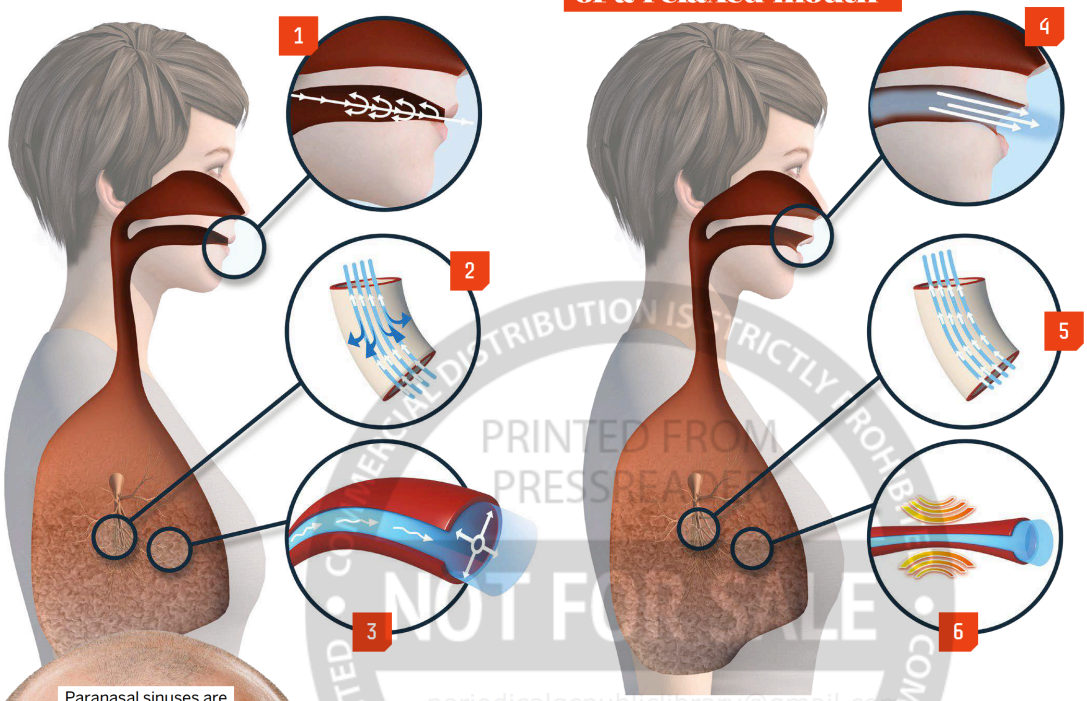
NON-PURSED-LIP BREATHING

4 REGULAR BREATHING
Air flows quicker out of a relaxed and widened mouth. The speed of airflow is around ten miles per hour.

5 NO BACK PRESSURE
Air moves quickly out of airways, making them more likely to close and lose elasticity.

6 CONSTRICTING VESSELS
Blood vessels with consistently low oxygen levels, such as those in COPD sufferers, start to close up to redirect blood flow to where oxygen is higher.

"Air flows quicker out of a relaxed mouth"




Paranasal sinuses are hollow spaces in the bones surrounding the nose

A HEALTHY HUM

One breathing technique that increases the volume of antibacterial, antiviral and antifungal nitric oxide in your airways is humming breathing. This breathing exercise simply involves humming while exhaling. Nitric oxide is always released from the sinuses around the nose and exhaled through the nasal cavity, but the sound waves released by humming increase sinus activity, causing them to release more. Humming can release 15 times as much nitric oxide into the nose, which helps remove pathogens and open up airways to make breathing easier.

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