Opening extract from

How Loud Can You Burp?

Written by and illustrated by

Glenn Murphy and Mike Phillips

Published by

Macmillan Children's Books

How Loud Can You BURP?

and other extremely important questions (and answers) from the Science Museum

Glenn Murphy

Illustrated by Mike Phillips

MACMILLAN CHILDREN'S BOOKS

First published 2008 by Macmillan Children's Books
a division of Macmillan Publishers Limited
20 New Wharf Road, London N1 9RR
Basingstoke and Oxford
Associated companies throughout the world
www.panmacmillan.com

ISBN 978-0-330-45409-4

1 3 5 7 9 8 6 4 2

A CIP catalogue record for this book is available from the British Library.

Typeset by Perfect Bound Limited
Printed and bound in Great Britain by Mackays of Chatham plc, Kent

Contents

To Mum and Dad – this one's for you, folks

Thanks to:

Deborah Bloxam, Damon McCollin-Moore and Gaby Morgan – for their encouragement, their tireless editing and that whole getting-me-to-write-stuff thing

Fran Bate, Emily Scott-Dearing, Dr Peter Morris, Doug Millard, Dan Albert, Alice Nicholls, Katie Maggs, Andrew Nahum, Tilly Blyth, Ben Russell and everyone else at the Science Museum and the NRM who offered their support and comments

Dr Dave Reay at Edinburgh University

Nina Davies and Professor Alun Williams at the Royal Veterinary College

The SCONCs (Science Communicators of North Carolina) – thanks for the hearty welcome

The Witts, the Murphs, the Grosses and the Soareses – especially Ben, Eric and Milo. It's a big world out there, lads – now get exploring.

Introduction

This is a book about questions. Your questions. And, believe me, I've heard a lot of them.

A little while ago, I wrote another book called *Why Is Snot Green?* That was about unanswered questions too. Maybe you read it. If not, you can always rush out and buy it later today. Hint, hint.

Anyway – the Snot-book questions came from visitors to the Science Museum, young and old.

Of course, I couldn't answer them all in just one go. But lots of people liked that little book. So we thought it would be a good idea to write another one. This one.

But this time I wanted more people's questions. I mean, not everybody can come to London and visit the Science Museum just so they can ask, right? So my mate Daniel came up with an idea.

'Why don't we make a web page?' he said. 'Then kids and adults from all over the country – all over the world, even – can read bits of your book and offer their own science-y questions.'

So that's what we did. And we got lots of questions. Hundreds of them. Some of these questions I'd already answered in the first book. And, of course, if you write a book called *Why Is Snot Green?* and ask for more questions for a sequel . . . a whole lot of people are going to give you something like this:

> You got a question from:
> **Name:** Toby
> **Question:** Why is poo brown?

> You got a question from:
> **Name:** Jessica
> **Question:** Why is pee yellow?

But, aside from that, you were a creative bunch, and you asked me all sorts of things. Things about your bodies and brains. About the biggest, the smallest and the fastest things in the world. You asked what planes, trains and cars might look like in the future. Lots of you seemed worried about the climate and what will happen to it. And, of course, there were a good number of you who thought: Great! Glenn can do my homework for me! Some of you were more obvious about this than others:

> You got a question from:
> **Name:** Clark
> **Question:** Will Glenn do my science project for me, it's on the universe and black holes thank you very much i expect 'A' quality work. Just send it in an email so i can print it. Pictures give extra credit so yeah add some thanks.

To all you homework-blaggers out there, I say this: YOU'RE 'AVIN' A LAUGH, AIN'TCHA? DO IT YERSELF!!

To everyone else that sent me a question – whether it made it into the book or not – I thank you. And I dedicate this book to you. Hope you like it.

Now let's get cracking . . .

Science of Me

From sunburn to snot, from breathing to burping, few of us ever stop wondering about how our bodies work and what makes us tick. Sure, we study bits of the body at school, and learn all about where our kidneys are, what our lungs do and stuff like that. But what about goosebumps, hiccups and hayfever? Why do we have eyelids but not earlids or noselids?

And what is that thing that dangles down the back of your throat called?*

This chapter is, quite literally, all about you. And you guys weren't short of questions about you, let me tell ya. Some, of course, were easier to answer than others:

You got a question from:
Name: James
Question: What would happen if you ate poo?

You'd almost certainly throw up, James. Unless you actually *like* eating poo, that is.**

And now, on to the rest . . .

* It's called a uvula. It stops food going up your nose and down your windpipe when you swallow.

** Seriously, I wouldn't try it. One gram of faeces contains around 10 million viruses, 1 million bacteria, plus parasite eggs and cysts. Eating poo can make you very ill indeed.

How loud can you burp?

The loudest burp on record is around 105 decibels – louder than a motorbike or chainsaw, and loud enough to cause real pain to anyone close enough to it. But don't try these at home, as they could be dangerous!

Louder than a motorbike?! No way!

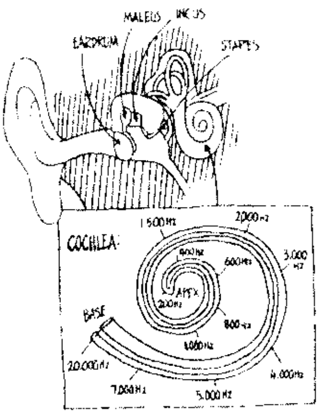
Yup. The world-record burp measured 104.9 decibels (decibels, or dB for short, are the units used to measure volume). And that was from over 2.5m away! Close up, the World Champion burper claims to be able to reach 118dB or more. The average motorbike roars away at around 90dB – a full twenty-eight units lower!

So who did it?

An English guy called Paul Hunn. He smashed the previous burping record in July 2004, and no one has topped it yet.

How could he burp so loud?

Well, like all sounds, burps are just waves of air pressure, and, if you make these waves big enough, any sound can become loud. To create a sound, an object – like a bell or guitar string – is made to vibrate back and forth very fast by striking it, plucking it or rubbing something against it. In turn, the object compresses the air molecules around it, making waves or vibrations that are carried through the air. When they reach your ears, these pressure waves vibrate your eardrums. From there, the vibrations are amplified by a set of little bones, picked up by a set of tiny hairs in your cochlea (which is a long, thin tube filled with



fluid and lined with hairs – all coiled up like a snail shell in your inner ear). Here the vibrations are finally translated into nerve signals that your brain interprets as sounds, such as 'bell', 'guitar string' or whatever.

But what about burps?

In the case of burps, the vibrating object is a fleshy flap called the cardia, which closes off the stomach from the food-tube, or oesophagus. When air is swallowed (either by accident while you're eating, or on purpose if you're trying to force a burp), it gets trapped in the stomach. As the stomach fills with food, liquid and gas, the pressure builds up and the air bursts through the flap – vibrating it on the way out and creating that deep, satisfying BRRRRRRRRRRRRRRPPPPP sound as it goes. Of course, if you want to *force* the burp out, you can squeeze your stomach by contracting your stomach muscles and diaphragm (which is the flat sheet of muscle underneath your stomach and lungs). This is how Mr Hunn made his burp so loud. Millions of kids around the world use the same method to force loud burps. He's just much better at it than anyone else. Oh, and he also swallowed lots of fizzy drink first.

Yeah – why *do* fizzy drinks make you burp like that?

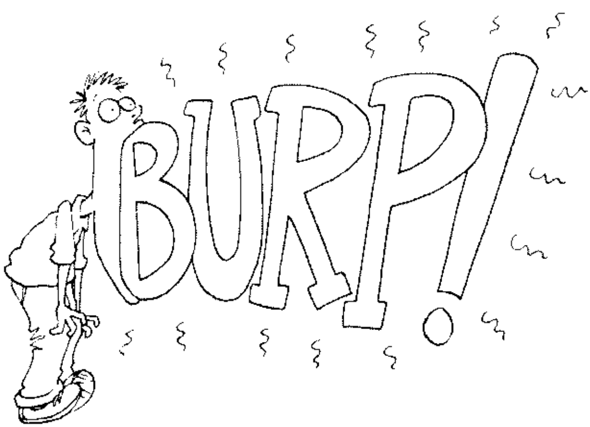
They're made bubbly and fizzy by adding carbon dioxide gas under pressure. So when you drink the drink, you swallow the gas. The gas builds up in your stomach, annnnd . . . you can figure out the rest.

Is it dangerous to make yourself burp like that?

Well, drinking lots of fizzy drinks isn't very good for you, and swallowing air on purpose won't do your stomach any good, but that's not really what makes burping as loud as Mr Hunn does dangerous. It's after the burp leaves the body that it becomes a danger to you and others.

But if a burp is just air and sound, how could it be dangerous to anyone?

If they're loud enough and at the right frequency, sounds can be very powerful and dangerous. Ever hear of opera singers who can shatter glass with their voices alone? Well, that's true. All they have to do is hit the right pitch, and sing the note loud enough, and the glass will vibrate and shake itself to pieces. And the US military have even developed a 'sound weapon' that fires waves of air



pressure and sound instead of bullets. The Vortex Ring Gun shoots a ring of vibrating air that can knock down a grown man over 10m away.

So if you burped loud enough, could you crack a person's glasses? Or knock a bunch of people over? That'd be sweet!

Err . . . no. Not quite. Even the most accomplished burper, like Mr Hunn, couldn't produce enough air pressure to knock someone down. And his burps are too low-pitched to crack glass. But he could burp loud enough to hurt your ears, or even damage them permanently.

What, really?

Yup – really. Mr Hunn burps at between 105 and 118 decibels. 85 decibels is enough to temporarily damage your hearing. Builders using pneumatic drills (which thump away at around 120dB) wear ear defenders to avoid getting hearing damage. If you burped at 165dB, that would be the same as a gunshot going off right next to your head. So burp this loud and you could deafen yourself and other people!

Yeah, and what a let-down too.

Why's that?

Just think – you can burp as loud as a gunshot, but after the first time no one can hear it. Not even you.

Err . . . yeah . . . that'd be a real tragedy.

Just one more thing . . .

What's that?

Do Brussels sprouts make you burp?

I don't . . . think so, no. Why do you ask?

They should do. Cos they come from Belch'um.

Oh *man*, that was bad.

Heh, heh.
BUUUURRRRRRRRRRRRPPPPPPPPPPP!!!!

Sci-facts: noisy stuff

The volume of a sound wave is related to its air pressure, and measured in decibels (dB). On the decibel scale, zero decibels marks the softest sound most people can hear (although some people can hear sounds at –10dB or lower). Here's how some common (and uncommon) noises measure up:

dB	Sound
0	rustling leaves
20	whisper
40	light rainfall
75	washing machine
90	motorbike
110	chainsaw, rock concert
115	one of Paul Hunn's burps (at close range)
130	jet aeroplane (from 30m away)
165	shotgun

Why do we get hiccups, and how do you stop them?

Hiccups are a funny one. We know what they are, we know what they do to our bodies and, for the most part, we know how to get rid of them. But we can't say for sure where they come from, or what they actually do in the body.

What is a hiccup, anyway?

A hiccup – or *singultus*, as medical scientists call it – is a kind of forced intake of breath, caused by muscle spasms in your chest and throat. There are over a hundred causes of hiccups, but the most common is irritation of the stomach or the oesophagus – the food tube that leads to the stomach. The 'hic' noise comes when the breath is cut off by the snapping shut of your *glottis* – which is like a fleshy lid or trapdoor that separates the food and air tubes in your throat.

So why are they called hiccups, rather than singultus-es or something?

Good question. That's because the word 'hiccup' is an example of onomatopoeia – a word that sounds like the thing it describes. So hiccups were named after the noise they make.

They weren't always called hiccups. In sixteenth-century English they were called *hickops*. By the seventeenth century they'd become *hiccoughs*, and by the eighteenth they were known as *hickets* or *hyckocks*. The 'hic' part seems pretty universal, as foreign words for hiccup sound similar. The French get *hoquets* and the

Japanese get *hyakkari*. The Germans suffer with the much wetter-sounding *schluckaufs*. Still – it's nice to know that everyone gets them, whatever they're called.

So if everyone gets them, what are they for, exactly?

The truth is, we're not really sure what they're for. According to some scientists, hiccups don't really do anything – they have no function in the body at all (other than to make us look daft). Instead, they think hiccups might be a kind of malfunction in the nerves that control the breathing muscles and glottis, which happens when the nerves get irritated or damaged.

Hiccups are useless, then?

Maybe, but then again maybe not. It could be that they're useless to us *now*, but they once served a purpose in the animals we evolved from. Another idea is that the hiccup evolved to help our four-legged ancestors to swallow food that got stuck in their throats. Where we humans have the luxury of gravity helping food down, quadrupeds (animals that walk on all fours) have to shift their food horizontally to get it from their mouths to their stomachs. This means it's easier for lumps of food to get stuck in their throats. Some scientists think that lumps lodged like this might press down on a nerve in the throat that triggers the hiccup. The sharp breath in then creates a vaccuum behind the food, and helps the animal suck down the lump. This might explain why dogs (not known for eating their food slowly) seem so prone to hiccups – they 'wolf' their food down in big lumps that they have to clear by hiccupping.

Fair enough. But why don't hiccups stop once you stop eating, then?

Well, sometimes they do, and sometimes they don't. Most cases of the hiccups are cured (or go away by themselves) inside a few minutes. Others can go on for weeks, or even years. In fact, doctors give names to different classes of hiccups, depending on how long they go on for. *Common hiccups* are gone within an hour. *Persistent hiccups* can go on for up to forty-eight hours, but are usually harmless (although very annoying!). *Acute hiccups* go on for more than forty-eight hours, and are usually caused by drugs, but they can also occur naturally. For example, in January 2007, a teenager from Florida named Jennifer Mee hiccupped for five weeks straight, for no known reason! If hiccups go on for longer than two months, they're classed as *intractable* or *diabolic hiccups*, and they're usually the sign of a serious illness.

Two months?! That sounds like a nightmare! Is that the longest they can go on for?

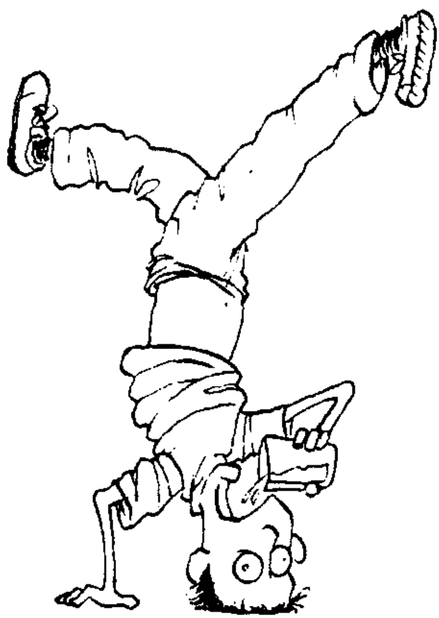
Well, the world record stands at 68 years, with a guy called Charles Osbourne (again, from the USA), who hiccupped continuously from 1922 to 1990. The poor guy basically had hiccups for life.

Right – I have to know. How do you get rid of hiccups, really? I heard that if you stand on your head and drink a glass of water . . . no, wait – you have to eat a raw chili pepper, right?

For common hiccups, there are literally hundreds of recommended 'cures' out there. Some involve eating or drinking things, others tell you to hold your breath. Some tell you to drink a glass of water in a certain way, others to get a friend to distract you. In reality, the ones that actually work (and many don't) do so by helping you get control of your breathing. So it doesn't really matter what you eat, or how you drink the water – it's just the interruption of your breathing pattern that does the trick. Holding your breath usually works best, since it's the most direct way of controlling your breathing muscles.

What about getting a friend to scare you?

That usually only works if the hiccups are *psychosomatic* – when you're setting off the jerky contraction in the breathing muscles yourself, but you're not aware that you're doing it. Kind of like imagining each hiccup into existence. It's not always easy to tell when this is happening, but getting someone to distract you can snap you out of it long enough for them to stop. Of course, none of these remedies is likely to work on acute or intractable hiccups. As they're usually started by drugs or nerve damage, they're often only treatable with more drugs. That said, some researchers have claimed success treating hiccups with needles, radiation or even digital rectal massage.



What's that, then?

A finger up the bum.

What?! I think I'd rather have hiccups!

Maybe so.

Top 10 weird hiccup cures (that may or may not work)

1. Breathe in and hold it until they're gone.
2. Eat a spoonful of mustard.
3. Eat a raw chili pepper.
4. Immerse your face in ice water.
5. Stand on your head.
6. Rub your earlobe.
7. Start running. Stop when the hiccups do.
8. Take off your left sock and breathe through it for one minute.
9. Tell yourself 'I haven't got the hiccups', 50 times.
10. Do nothing – just wait for the next hiccup. Repeat until it doesn't come.

Why do we breathe, and why do we need lungs to do it?

We breathe to capture oxygen, which helps us convert food into energy in our cells, and to get rid of carbon dioxide – the waste gas that is formed as this happens. Our lungs pump these gases in and out of our bodies, and help us dissolve them in and out of our blood.

So let me get this straight – we breathe so that our cells can eat food?

Not exactly, but close. It's more like 'we breathe so that our cells can breathe, and eat so that our cells can eat'.

What? They *breathe* too? Now I'm really confused . . .

OK, let's go back a bit. If you think about it, cells are like little units of life. The smallest living things, bacteria, are just individual cells swimming about eating stuff. They absorb sugars or other nutrients from the air or liquid around them, and turn this 'food' into energy – which they can use to grow, multiply and squidge around looking for more food.

Got that.

OK. Now some of these bacteria eventually evolved into bigger creatures like fish, frogs, lizards, monkeys and human beings. Those particular types of bacteria are called aerobic bacteria, which means . . .

. . . that they wore tracksuits and did lots of exercise?

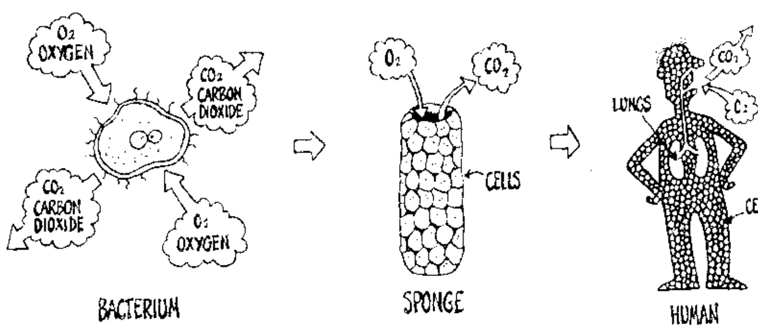
Err . . . no. It means they have to 'breathe' (or take in) oxygen in order to turn their food into energy.

Oh yeah, of course. I knew that. I mean, nobody makes tracksuits that small, for starters.

Err . . . right. Anyway, these bacteria and the animal cells they evolved into all need to take in oxygen for that same reason – to fuel their food-processors and produce usable energy.

But why do they need oxygen to do that? Couldn't they do it without oxygen?

Well, they can for a while, at least. But the main power source for aerobic bacteria and cells comes from a chain reaction which uses oxygen – so they can't survive without it for long. Oxygen and nutrients go into this reaction, then energy and carbon dioxide come out. The energy is stored and moved around in special molecules, while the carbon dioxide has to be removed from the cell, as it forms an acid if too much of it builds up. So, in a way, aerobic



bacteria 'breathe in' oxygen and 'breathe out' carbon dioxide. These bacteria evolved into complex animals by clustering together and eventually developing into the cells, tissues, organs and systems that make whole animal bodies. But, since each cell still needs nutrients and oxygen for energy, the whole animal has to keep eating and breathing just to supply them.

OK – that kind of makes sense. But why do bigger animals need lungs to breathe?

Well, if you think about it, the bigger an animal gets, the more cells it has, and the further away from the air its insides are. Up to a certain size, animals can absorb oxygen through their skin and let it spread through their tissues. But most things bigger than flatworms need air tubes of some kind to get air to the inner parts of the body (that works for insects and spiders, at least). For larger, more complex or more active animals, you need some kind of gas-exchanging air pump. That's where lungs come in.

But not all animals have lungs, right? I mean, fish don't, do they?

Right – they don't. Fish have gills instead. They swallow water and use their gills to absorb the oxygen dissolved in it. Then the gills dump carbon dioxide back into the water before pushing it out. That's what's happening when you see the gills 'flapping' on a fish.

So why can't we just swallow oxygen and burp out the carbon dioxide?

Well, then you'd be swallowing continuously, every few seconds, all day long. Like a big, walking air-fish. Not much fun, and kind of tricky to hold down

conversations. Plus it wouldn't work anyway, since swallowed air goes to your stomach – which is already specialized for digesting food, and is too small for exchanging breathing gases.

Why does size matter?

You need a large surface area for the gas exchange to happen quickly enough between the air you take in and your bloodstream, which carries it to cells throughout the body. That's where lungs come in handy. They're more than just air sacks – they're like giant air sponges which soak up and exchange gases very quickly through thousands of tiny bobbles, called alveoli.

You're telling me I have pasta in my lungs?

No. That's ravioli.

Oh. I knew that.

Alveoli are the clustered, berry-like bobbles found at the end of the branching air tubes deep in your lungs. They help increase the surface area of your lungs so much that if you flattened them all out into one sheet, it'd cover about 75 square metres – roughly the size of a tennis court. When you breathe in, muscles around and beneath the lungs help them suck air into the alveoli. These are covered in tiny blood vessels so that oxygen can move into the bloodstream and be carried around the body. Carbon dioxide gas moves the other way – the bloodstream carries it out of organs and tissues and back to the air inside the alveoli, ready to be pumped out again as you breathe out. And there you have it – you and all your cells have all the oxygen they need, provided you keep breathing air, and avoid damaging all your delicate breathing equipment with dangerous fumes or cigarette smoke.

Got it. Don't breathe cigarette smoke – or pasta – and your cells can keep doing aerobics.

Something like that.

Sci-Facts: lungs and stuff

The animal with the *largest lungs on Earth* is the **blue whale**, which may also be the largest animal ever to have lived. At up to 30m long and 135 tonnes in weight, the blue whale is even larger than the biggest dinosaurs ever found. A blue whale's lungs hold up to 2,000 litres of air – compared with about four litres for the average human.

Elephant seals and **sperm whales** can hold a single breath for up to two hours! The human world record stands at 15 minutes 2 seconds, achieved by German diver **Tom Sietas** in August 2007.

The lungs are the **largest organs** in the human body (unless you count the skin, which can be thought of as an organ or a tissue). The average male lungs weigh about 1kg, while the average weight for female lungs is 930g. This doesn't explain, however, why boys are usually louder . . .

Why do we have eyelids, but not earlids?

Because eyelids helped us – or rather our animal ancestors – to survive, whereas earlids would've made little difference to whether they survived or not.

How could eyelids help us survive? I mean, what makes *them* so important?

Well, what makes *any* bit of your body important? What about your hands – what good are they?

That's easy – we can use them to pick things up and make things. Use tools and stuff.

Right – and how would that have helped our early human ancestors survive?

They could build shelters. And catch food. And make fires for cooking it.

Spot on. But how many of those things could they have done easily without being able to see?

Err . . . dunno. I guess they could have just about done them. But it would've been much harder. But we're talking about eyelids, not eyes. You can still see without eyelids, can't you?

Yes, you can. But, if you're a land animal, then not for long.