Why Don't Cars Run on Apple Juice?

Real Science Questions from Real Kids

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annick press
toronto • berkeley

Created in cooperation with the Ontario Science Centre

Designed by Paul Covello

Annick Press Ltd.

We acknowledge the support of the Canada Council for the Arts and the Ontario Arts Council, and the participation of the Government of Canada/la participation du gouvernement du Canada for our publishing activities.

Canada

ONTARIO ARTS COUNCIL
CONSEIL DES ARTS DE L'ONTARIO
an Ontario government agency
un organisme du gouvernement de l'Ontario

Library and Archives Canada Cataloguing in Publication
Title: Why don't cars run on apple juice? : real science questions from real kids / Kira Vermond ; Suharu Ogawa, illustrator.
Names: Vermond, Kira, author. | Ogawa, Suharu, 1979- illustrator.
Description: Includes index.
Identifiers: Canadiana 20190066954 | ISBN 9781773213019 (softcover)
Subjects: LCSH: Science—Miscellanea—Juvenile literature. | LCSH: Technology—Miscellanea—Juvenile literature.
Classification: LCC Q163 .V47 2021 | DDC j500—dc23

Published in the U.S.A. by Annick Press (U.S.) Ltd.
Distributed in Canada by University of Toronto Press.
Distributed in the U.S.A. by Publishers Group West.

Printed in China

annickpress.com
kiravermondkids.com
suharuogawa.com
ontariosciencecentre.ca

Also available as an e-book. Please visit annickpress.com/ebooks for more details.

For Nathan who asked why, Nadia who asked how, and Dave who has all the answers.

—KV

For all the curious kids and kids-at-heart.

—SO

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Stars, Moons, Planets, and Outer Space

Big Ideas Past, Present, and Future

Introduction

Have you ever asked a question? Of course you have! Everything around us—from the deepest, darkest spot in the ocean to our twinkling stars above—fires up the imagination and inspires us to want to know more.

But there's a funny thing about questions: they always seem to lead to more questions. Check it out!

Question: "Is the center of the Earth hot?"

Answer: "Yes."

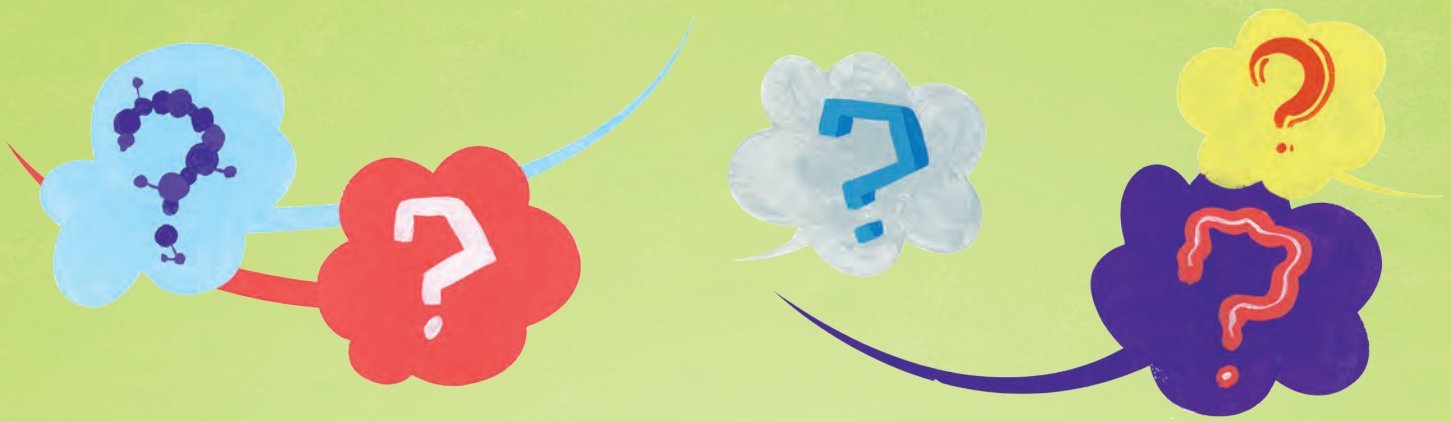
"How hot does it get?"

"If we can't travel to the center of the Earth to take its temperature, how do we measure it?"

"Is that why volcano lava is so hot?"

"What would happen if I threw a big diamond into a vat of lava?"

"If the human body is 18 percent carbon, can I be turned into a diamond?"



That's perfectly fine! The universe is a big, complex, and puzzling place, but humans have a powerful tool to help us make sense of it.

It's called SCIENCE.

Ask. Test. Repeat. It works.

Science isn't just a class at school. It's not a thing. Science is a process of asking questions in a way that helps us find answers that we can test to see if they're true. (At least based on what we know at the time.)

It's okay if the questions are hard and the answers confusing at first. (Scientists spend a lot of time scratching their heads.) That just means you need to keep asking more questions!

Real Kids, Real Questions

Every question in this book came from kids who visited the Ontario Science Centre in Toronto, Canada—at a café where the amazing and intriguing things they asked were captured in a computer and laser-cut into personalized wooden coasters. They even got to keep them. Cool!

Educators and science researchers who work at the Centre came up with answers. But that's just the beginning! Hopefully this book will spark some new ideas and get you to ask yourself one very big question: What are you wondering about these days?

CHAPTER 1
I've got questions about . . .

Whipping Up a Batch of Planet Earth

Pretend you live on a planet without air, water, or rock beneath your feet. What does that look like? (Hint: not much!)

Luckily, planet Earth is made up of amazing elements like oxygen, carbon, and sodium that give us everything we need to thrive. Check out these answers to some of your most elemental questions.

Why is ocean water salty?

Ever take a gulp of cool, refreshing . . . seawater? Blegh. Salty! It turns out there are loads of salt in our oceans. In fact, if you spread that salt across the Earth's entire land surface, it would form a layer 152 meters (500 feet) deep, roughly as tall as a 40-story building!

So how did it get there? It starts with rain. Water that falls from the sky is a tiny bit acidic. When that rainwater hits rocks on the ground, it dissolves the minerals in the rocks. Those minerals then enter rivers and streams and flow into the ocean. When the Sun comes out, the seawater heats up a little and evaporates, causing the remaining water to become even saltier.

Freshwater Fact!

Lakes and rivers contain salt and other minerals, too, but they are less salty than our oceans, so we can't taste it.

Why is some water turquoise and some water brown?

Water is actually perfectly clear. But a funny thing happens in large bodies of water such as rivers, lakes, or oceans. As sunlight passes through all the little droplets, the light splits up and scatters, creating a very faint blue tinge. Water reflects the blue sky above it, too.

Water also tends to pick up the color of what's in it.

Turquoise water found in mountain lakes and streams is often full of finely ground rock from ancient glaciers. The bright, bluish-green color we see is caused by the way light bounces off all those tiny rock particles.

Brown water might include a lot of stirred-up dirt, clay, or sand. One river in Alberta, Canada, sometimes looks pink! Iron and other colorful minerals flow through it.

If metal sinks, how do boats float?

Have you ever seen a towering cruise ship docked on dry land? It just doesn't seem possible that something that large, filled with people and made from metal, could stay afloat on water. Even a small fishing boat seems iffy. But boats rely on two nifty science tricks called displacement and up-thrust to keep from sinking.

If a boat weighs less than the amount of water it pushes aside (displaces), it floats. All that displaced water needs to go somewhere, so it thrusts up to the water's surface. This balancing act—the boat sinking down and the water rushing up—keeps the boat afloat.

And don't forget: unlike a dense bar of metal, which would most certainly sink, a boat's interior is full of air, making the boat lighter than the water below it. That helps, too.

How does gravity keep us down?

Go ahead. Set this book down for a moment.

What just happened? Did it float away? Unless you're reading this in space, your book probably didn't go anywhere. Thank gravity.

Gravity is an invisible force that pulls objects toward each other (in this case, the book toward the Earth). Without gravity, we couldn't survive on this planet. It keeps our atmosphere in place and our air close to us so we can breathe. And while Earth's gravity keeps you from flying into space, that's nothing compared to the Sun's gravitational pull. It's so strong that entire planets spin in orbit around the Sun! Without that gravity, Earth would float away from the Sun and become too cold to live on.

No one knows exactly how gravity works, but Albert Einstein had a theory that goes a long way toward explaining the mysterious force. He believed the entire universe is filled with the fabric of space and time.

Imagine dropping a really heavy bowling ball in the middle of a trampoline. What happens? The ball creates a deep well in the center, right? Now imagine placing a marble at the edge of the trampoline. It would roll toward the bowling ball, unless you and your friends started bouncing!

Earth is just like the bowling ball. When dropped deep into the fabric of space, it creates a "gravity well." And, like the marble, you can't jump out of it. You just get sucked back to Earth.

Only something moving really fast can get out of the well and escape Earth's gravity. Rockets can do it—by traveling at speeds faster than 40,000 kilometers (24,855 miles) an hour!

Where does wind come from?

Wind. We use it to fly kites, dry our clothes, sail our boats, and even power our houses. On winter days, it can also chill us to our bones. Brrr! Wind is so much a part of our lives, we don't often wonder why air moves around in the first place. To answer that question, it helps to understand two important rules about air:

1. Hot air rises and cool air sinks.
2. Air pressure is the weight of air molecules pushing down on the Earth. The higher you go, the less air pressure there is.

Got it? Good.

As the Sun heats up areas of land, the air gets hotter, rises, and leaves behind an area where there's less air pressure. Cooler, heavier air that hangs out over oceans and large lakes swoops in and takes its place. The quick movement of those air molecules is what we call wind.

Why can't we feel the Earth moving?

Here's a wild thought. As you sit and read this book, you're also moving at an incredible 460 meters (1,500 feet) per second as Earth spins on its axis and rotates around the Sun. So why don't you feel it?

Unlike riding a bicycle, with the air whipping through your hair, the scenery whizzing by, and the bumpy road below your wheels, you don't experience Earth's movement as a sensation.

Although our scenery changes—the Sun, stars, and Moon seem to travel (slowly) across our sky—there is no rough road underneath Earth to give us the sense that we're going anywhere. What's more, everything around us is moving at exactly the same speed as everything else. Oceans, cities, trees, giraffes, your grumpy school principal. You name it.

It's kind of like flying in a large airplane. Even though you're traveling 805 kilometers (500 miles) per hour, unless you look out the window, you might not feel like you're moving at all.