QUESTIONS TO SLEEP ON

What's the Biggest Number?

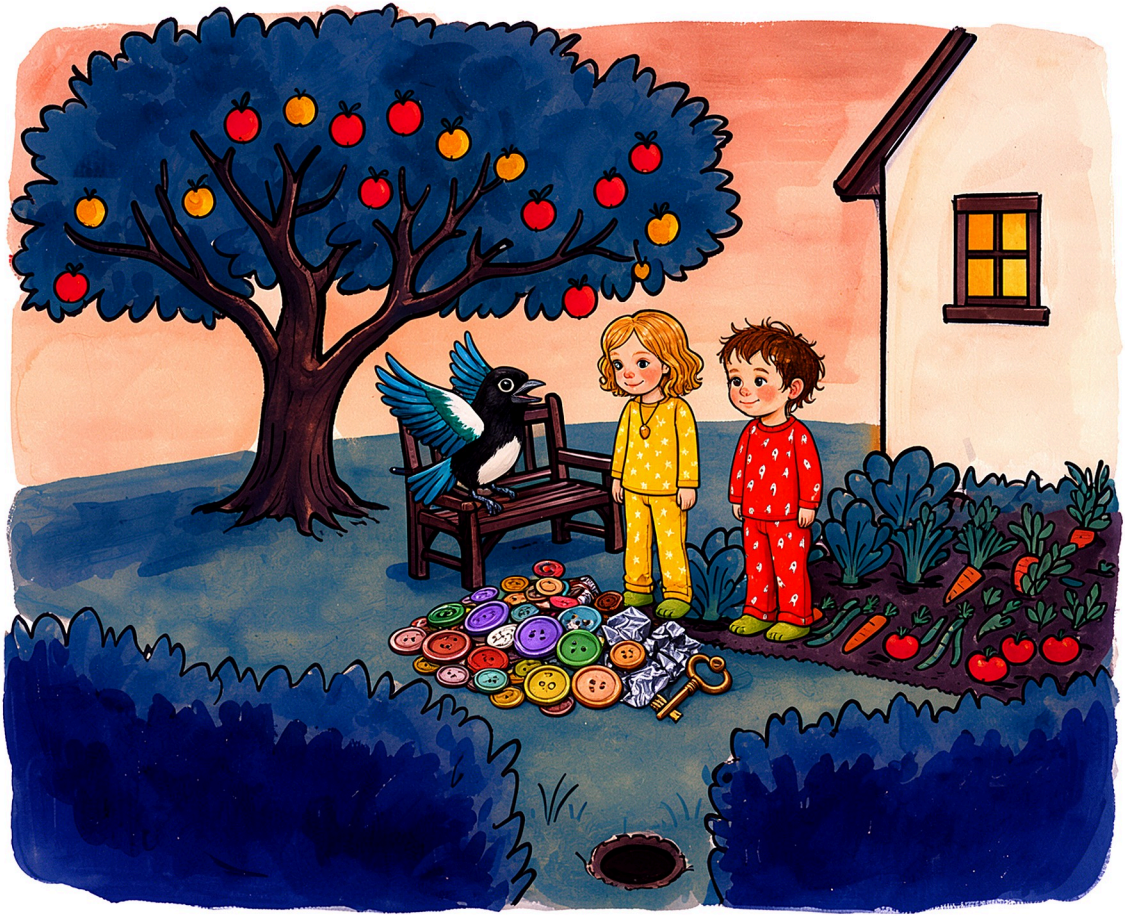


Book 1 · For Lara and Zac



When the lamp goes warm and the garden goes quiet, Ponder comes out to wonder.

Ponder is a tortoise. She lives in a hollow under the hedge at the bottom of the garden, and she is very, very old. Tonight, Lara and Zac pulled their wellies on over their pyjamas and went out to say hello.



Pip the magpie landed with a clatter. “I’ve got a HUNDRED shiny things,” he said.

> Bottle tops. Buttons. A key. A curl of silver foil. Pip puffed out his chest until he was nearly round. “A hundred is the biggest number there is.”



“A hundred and ONE!” said Zac, and he held up Bunny.

> Because Bunny was one more thing, obviously. Pip’s feathers went flat. He had not thought of that.



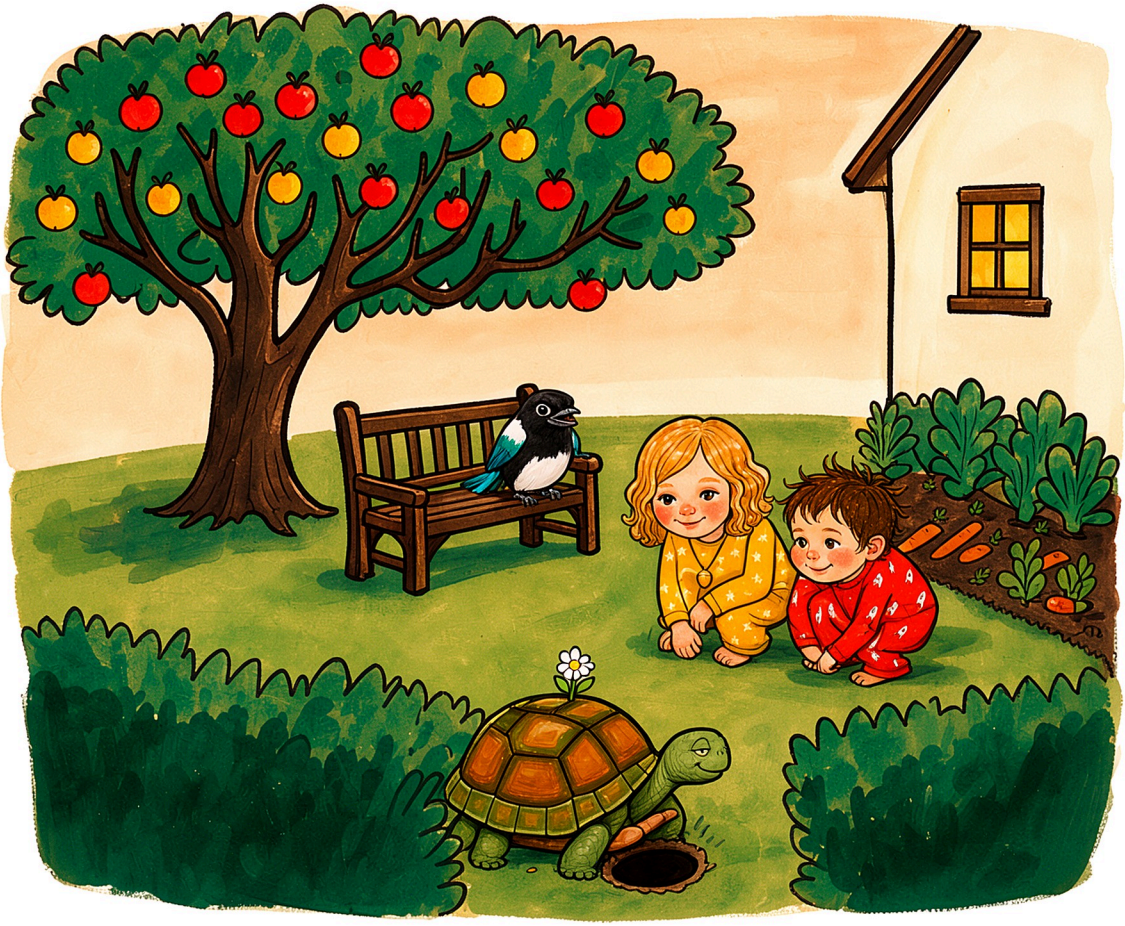
“A million is bigger,” said Lara. “A million and ONE!” said Zac.

> A million is so big that if you said one number every second, all day and all night, without stopping for breakfast, it would take you about eleven days to get there.



“A MILLION MILLION!” shouted Pip. “That’s the biggest number in the whole world.”

> Pip flapped so hard that a button fell off his pile and rolled away under the bench. Lara opened her mouth. Zac opened his mouth. But somebody else spoke first.



From under the hedge, very slowly, came Ponder. “Hmm,” she said. “**...and one more?**”

> Ponder took a long time to say anything, because she was about a hundred and fifty years old, give or take a Tuesday, and she did not like to rush.



“A million million and one!” said Zac.
“**...and one more!**” said Lara.

Pip tried a gazillion. Pip tried a squillion-zillion-trillion. And every single time, Zac said, “And one more!” Lara frowned. “Do numbers go on forever?”



“Ponder,” said Lara, “is there a number so big that you CAN’T add one more?”

Ponder blinked very slowly, once, twice. The first star came out above the apple tree. “Hmm,” said Ponder. “I wonder. What do you think?”



“Long ago,” said Ponder, “a man called Archimedes tried to count every grain of sand in the world.”

Every beach. Every desert. People told him it couldn’t be done, because sand goes on forever. “Big, yes,” said Archimedes. “But forever? Hmm.” And he found a way to write down a number bigger than all the sand.



They lay on the grass and counted the stars. One, two, three… **and one more… and one more.**

> Every time Lara thought she had counted them all, another star came out. “Maybe numbers are like stars,” she said. “They just keep going.” “Or maybe,” said Pip, “there’s a last one. And it’s MINE.”



Back in bed, Zac counted sheep. One sheep, two sheep... **and one more...**

> "Does counting go on forever?" asked Lara. "Not mine," said Zac, and he did the biggest yawn in the whole world. Or nearly the biggest. There's always one more.



“Some questions are for sleeping on,” said Ponder. “Night night, Ponder.”
“Hmm. Night night. I wonder…”

> Outside, the stars kept on coming out, one more and one more and one more, all night long.

Ponder's question

Is there a number so big that you can't add one more?

ZAC
Show me with your arms how big the biggest number is. Now... and one more?

LARA
If you counted forever, would you ever get to the end? How do you know?



Some people think...

There must be *a* biggest number, because everything stops somewhere.

There isn't one. You can always add one more, so numbers go on forever.

The biggest number is the one you get to when you're too sleepy to count.

Or something else?

You're allowed to agree. You're allowed to disagree.

For grown-ups

The question: Is there a biggest number, or do numbers go on forever? And what would "forever" even mean?

Its name: Infinity. The "and one more" argument; Aristotle's distinction between potential and actual infinity.

Where it comes from: Archimedes, *The Sand Reckoner* (3rd century BC; T. L. Heath's translation, 1897, is public domain). Archimedes did not claim the sand was infinite. He showed it was finite but enormous, which is a nice twist to keep in your pocket. Aristotle, *Physics* Book III, on potential infinity.

QUESTIONS, LITTLE TO BIG

1. Is a million bigger than a hundred? (Thumbs up or down.)
2. Why can Pip never win the game?
3. Have you ever tried to count something that kept on going?
4. What if you counted forever and ever? Would you be finished?

WHAT THEY MIGHT SAY

Zac (3): "A hundred and one!", or "Bunny number!" Little ones often think the biggest number is the biggest word they know. Play the "and one more" game rather than correcting them.

Lara (6): Six-year-olds often spot the pattern ("you can always add one") and then get stuck on whether "infinity" is a number. Mathematicians argued about exactly that for two thousand years.

TOMORROW

Build a tower of blocks. Could we ever add the very last block? What stops us, the numbers or the ceiling?

How to wonder together: ask, then wait. Say their words back to them. "Can you say more?" "Someone might say…" Don't say "right" or give your answer; Ponder never does. Too big for tonight? "Let's wonder about that at breakfast." (Then do.)