



Lucy & Stephen
HAWKING

with Christophe Galfard

Illustrated by Garry Parsons

Simon & Schuster Books for Young Readers
New York London Toronto Sydney

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George's Secret Key to the Universe, visit
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For William and George, with love

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Lucy Hawking



Pigs don't just vanish, thought George as he stood staring into the depths of the very obviously empty pigsty. He tried closing his eyes and then opening them again, to see if it was all some kind of horrible optical illusion. But when he looked again, the pig was still gone, his vast muddy pink bulk nowhere to be seen. In fact, when George examined the situation for a second time, it had gotten worse, not better. The side door of the pigsty, he noticed, was hanging open, which meant someone hadn't shut it properly. And that someone was probably him.

"Georgie!" he heard his mother call from the kitchen. "I'm going to start supper in a minute, so you've only got about an hour. Have you done your homework?"

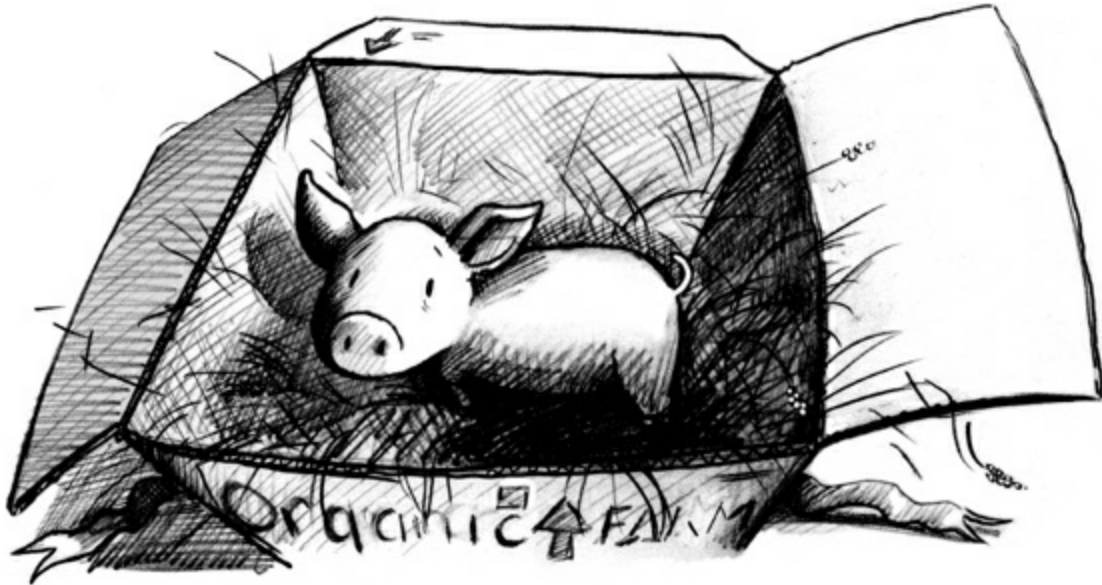
"Yes, Mom," he called back in a fake cheery voice.

"How's your pig?"

"He's fine! Fine!" said George squeakily. He threw in a few experimental oinks, just to make it sound as though everything was business as usual, here in the small backyard that was full of many, many vegetables and one enormous—but now mysteriously absent—pig. He grunted a few more times for effect—it was very important his mother did not come out into the garden before George had time to think up a plan. How he was going to find the pig, put it back in the sty, close the door, and get back in time for supper, he had no idea. But he was working on it, and the last thing he needed was for one of his parents to appear before he had all the answers.



George knew the pig was not exactly popular with his parents. His mother and father had never wanted a pig in the backyard, and his dad in particular tended to grind his teeth quite hard when he remembered who lived beyond the vegetable patch. The pig had been a present: One cold Christmas Eve a few years back, a cardboard box full of squeaks and snuffles had been delivered to their front door. When George opened it up, he found a very indignant pink piglet inside. George lifted him carefully out of the box and watched with delight as his new friend skidded around the Christmas tree on his tiny hooflets. There had been a note taped to the box. *Dear all! it read. Merry Christmas! This little fellow needs a home—can you give him one? Love, Grandma xxx.*

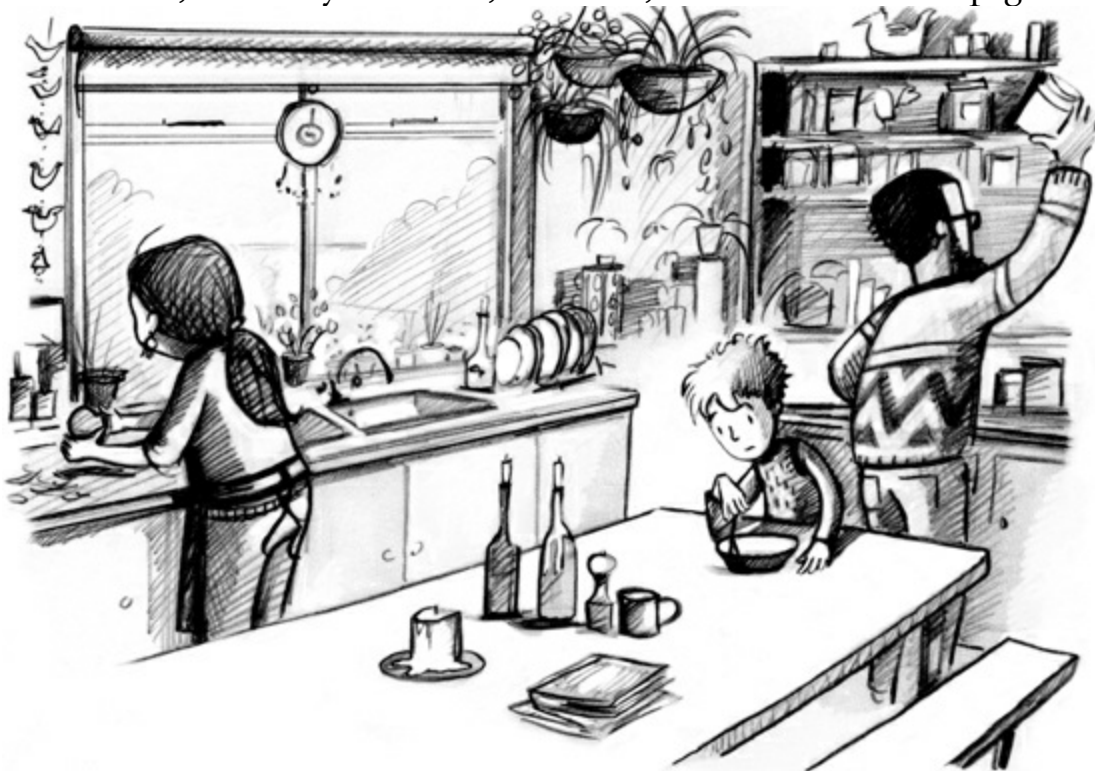


George's dad hadn't been delighted by the new addition to his family. Just because he was a vegetarian, it didn't mean he liked animals. Actually, he preferred plants. They were much easier to deal with: They didn't make a mess or leave muddy hoofprints on the kitchen floor or break in and eat all the cookies left out on the table. But George was thrilled to have his very own pig. The presents he'd received from his mom and dad that year were, as usual, pretty awful. The home-knitted purple-and-orange striped sweater from his mom had sleeves that stretched right down to the floor; he had never wanted a xylophone, and he had a hard time looking enthusiastic when he unwrapped a build-your-own ant farm.

What George really wanted—above all things in the Universe—was a computer. But he knew his parents were very unlikely to buy him one. They didn't like modern inventions and tried to do without as many standard household items as they could. Wanting to live a purer, simpler life, they washed all their clothes by hand and didn't own a car and lit the house with candles in order to avoid using any electricity.

It was all designed to give George a natural and improving upbringing, free from toxins, additives, radiation, and other such evil phenomena. The only problem was that in getting rid of everything that could possibly harm George, his parents had managed to do away with lots of things that would also be fun for him. George's parents might enjoy going on environmental protest marches or grinding flour to make their

own bread, but George didn't. He wanted to go to a theme park and ride on the roller coasters or play computer games or take an airplane somewhere far, far away. Instead, for now, all he had was his pig.



And a very fine pig he was too. George named him Freddy and spent many happy hours dangling over the edge of the pigsty his father had built in the backyard, watching Freddy root around in the straw or snuffle in the dirt. As the seasons changed and the years turned, George's piglet got bigger . . . and bigger . . . and bigger . . . until he was so large that in dim lighting he looked like a baby elephant. The bigger Freddy grew, the more he seemed to feel cooped up in his pigsty. Whenever he got the chance, he liked to escape and rampage across the vegetable patch, trampling on the carrot tops, munching the baby cabbages, and chewing up George's mom's flowers. Even though she often told George how important it was to love all living creatures, George suspected that on days when Freddy wrecked her garden, she didn't feel much love for his pig. Like George's dad, his mom was a vegetarian, but George was sure he had heard her angrily mutter "sausages" under her breath when she was cleaning up after one of Freddy's more destructive outings.

On this particular day, however, it wasn't the vegetables that Freddy had destroyed. Instead of charging madly about, the pig had done

something much worse. In the fence that separated George's garden from the one next door, George suddenly noticed a suspiciously pig-sized hole. Yesterday it definitely hadn't been there, but then yesterday Freddy had been safely shut in his sty. And now he was nowhere to be seen. It meant only one thing—that Freddy, in his search for adventure, had burst out of the safety of the backyard and gone somewhere he absolutely should not have gone.

Next Door was a mysterious place. It had been empty for as long as George could remember. While all the other houses in the row had neatly kept backyards, windows that twinkled with light in the evenings, and doors that slammed as people ran in and out, this house just sat there—sad, quiet, and dark. No small children squeaked with joy early in the morning. No mother called out of the back door to bring people in for supper. On the weekends, there was no noise of hammering or smell of fresh paint because no one ever came to fix the broken window frames or clear the sagging gutters. Years of neglect meant the garden had rioted out of control until it looked like the Amazon jungle had grown up on the other side of the fence.

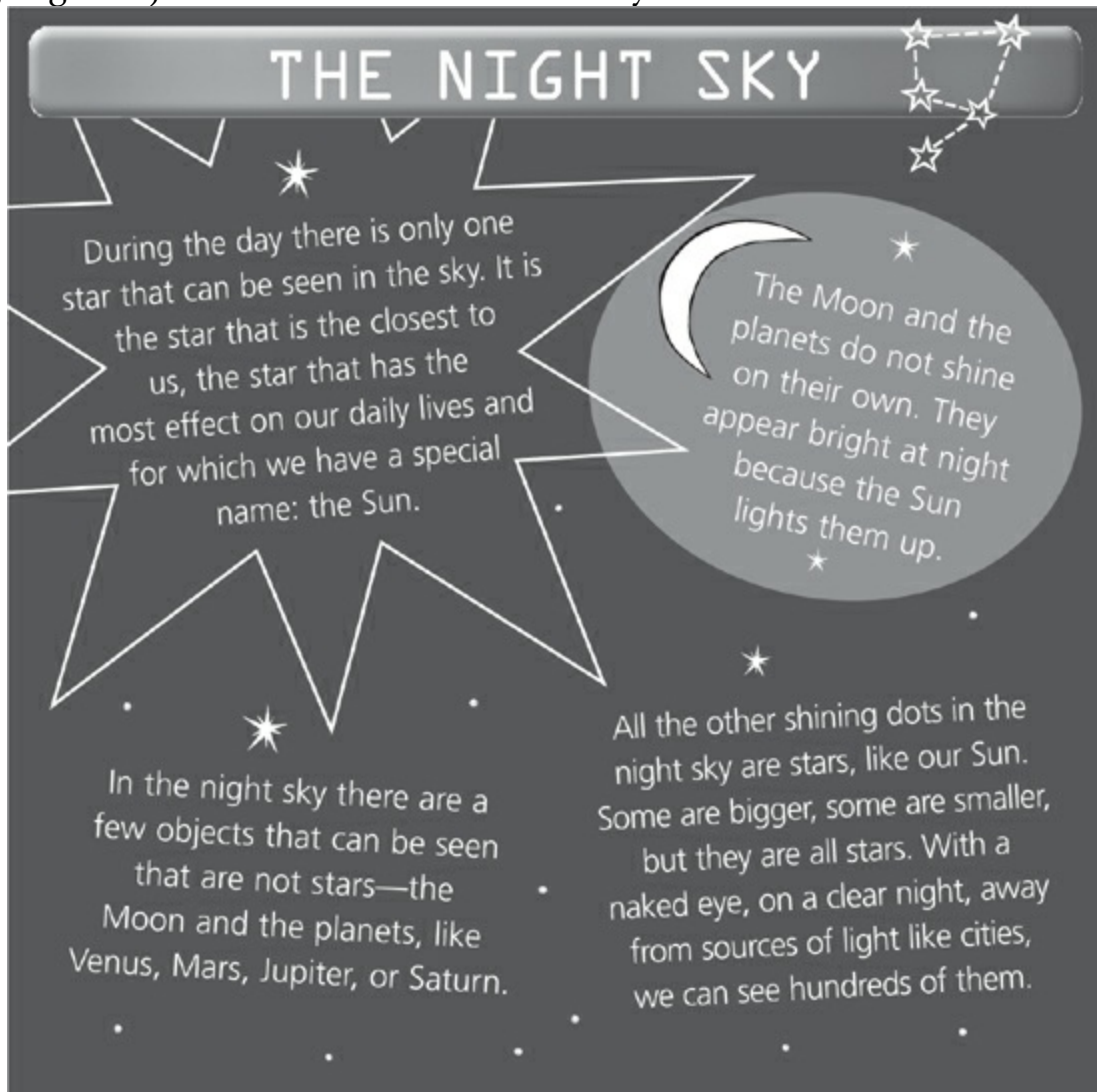
On George's side, the backyard was neat, orderly, and very boring. There were rows of string beans strictly tied to stakes, lines of floppy lettuces, frothy dark green carrot tops, and well-behaved potato plants. George couldn't even kick a ball without it landing *splat* in the middle of a carefully tended blueberry bush and squashing it.



George's parents had marked out a little area for George to grow his own vegetables, hoping he would become interested in gardening and perhaps grow up to be an organic farmer. But George preferred looking up at the sky to looking down at the earth. So his little patch of the planet stayed bare and scratchy, showing nothing but stones, scrubby weeds, and bare ground, while he tried to count all the stars in the sky to find out how many there were.

Next Door, however, was completely different. George often stood on top of the pigsty roof and gazed over the fence into the glorious tangled forest beyond. The sweeping bushes made cozy little hidey-holes, while the trees had curved, gnarled branches, perfect for a boy to climb. Brambles grew in great clumps, their spiky arms bending into strange, wavy loops, crisscrossing each other like train tracks at a station.

In summer, twisty bindweed clung on to every other plant in the garden like a green cobweb; yellow dandelions sprouted everywhere; prickly poisonous giant hogweed loomed like a species from another planet, while little blue forget-me-not flowers winked prettily in the crazy bright green jumble of Next Door's backyard.



But Next Door was also forbidden territory. George's parents had very firmly said no to the idea of George using it as an extra playground. And it hadn't been their normal sort of no, which was a wishy-washy, kindly, we're-asking-you-not-to-for-your-own-sake sort of no. This had been a real no, the kind you didn't argue with. It was the same no that George had encountered when he tried suggesting that, as everyone else at school had a television set—some kids even had one in their bedroom!—maybe his parents could think about buying one. On the subject of

television, George had had to listen to a long explanation from his father about how watching mindless trash would pollute his brain. But when it came to Next Door, he didn't even get a lecture from his dad. Just a flat, conversation-ending no.

George, however, always liked to know *why*. Guessing he wasn't going to get any more answers from his dad, he asked his mother instead.

"Oh, George," she had sighed as she chopped up Brussels sprouts and turnips and threw them into the cake mix. She tended to cook with whatever came to hand rather than with ingredients that would actually combine to make something tasty. "You ask too many questions."

"I just want to know *why* I can't go next door," George persisted. "And if you tell me, I won't ask any more questions for the rest of the day. I promise."

His mom wiped her hands on her flowery apron and took a sip of nettle tea. "All right, George," she said. "I'll tell you a story if you stir the muffins." Passing over the big brown mixing bowl and the wooden spoon, she settled herself down as George started to beat the stiff yellow dough with the green and white vegetable speckles together.



“When we first moved here,” his mom began, “when you were very small, an old man lived in that house. We hardly ever saw him, but I remember him well. He had the longest beard I’ve ever seen—it went right down to his knees. No one knew how old he really was, but the neighbors said he’d lived there forever.”

“What happened to him?” asked George, who’d already forgotten that he’d promised not to ask any more questions.

“Nobody knows,” said his mom mysteriously.

“What do you mean?” asked George, who had stopped stirring.

“Just that,” said his mom. “One day he was there. The next day he wasn’t.”

“Maybe he went on vacation,” said George.

“If he did, he never came back,” said his mom. “Eventually they searched the house, but there was no sign of him. The house has been empty ever since and no one has ever seen him again.”

“Gosh,” said George.

“A little while back,” his mom continued, blowing on her hot tea, “we heard noises next door—banging sounds in the middle of the night. There were flashing lights and voices as well. Some squatters had broken in and were living there. The police had to throw them out. Just last week we thought we heard the noises again. We don’t know who might be in that house. That’s why your dad doesn’t want you going around there, Georgie.”



As George looked at the big black hole in the fence, he remembered the conversation he’d had with his mom. The story she’d told him hadn’t stopped him from wanting to go Next Door—it still looked mysterious and enticing. But wanting to go Next Door when he knew he couldn’t was one thing; finding out he actually *had* to was quite another. Suddenly Next Door seemed dark, spooky, and very scary.

George felt torn. Part of him just wanted to go home to the flickery candlelight and funny familiar smells of his mother’s cooking, to close the back door and be safe and snug inside his own house once more. But that would mean leaving Freddy alone and possibly in danger. He couldn’t ask his parents for any help in case they decided that this was the final black mark against Freddy’s name and packed him off to be made into bacon. Taking a deep breath, George decided he had to do it. He had to go Next Door.

Closing his eyes, he plunged through the hole in the fence.

When he came out on the other side and opened his eyes, he was right in the middle of the jungle garden. Above his head, the tree cover was so dense he could hardly see the sky. It was getting dark now, and the thick forest made it even darker. George could just see where a path had been trampled through the enormous weeds. He followed it, hoping it would lead him to Freddy.

He waded through great banks of brambles, which grabbed at his clothes and scratched his bare skin. They seemed to reach out in the semidarkness to scrape their prickly spines along his arms and legs. Muddy old leaves squished under his feet, and nettles attacked him with their sharp, stinging fingers. All the while the wind in the trees above him made a singing, sighing noise, as though the leaves were saying, *Be careful, Georgie . . . be careful, Georgie.*



The trail brought George into a sort of clearing right behind the house itself. So far he had not seen or heard any sign of his wayward pig. But there, on the broken paving stones outside the back door, he saw only too clearly a set of muddy hoofprints. From the marks, George could tell exactly which way Freddy had gone. His pig had marched straight into the abandoned house through the back door, which had been pushed open just wide enough for a fat pig to squeeze through. Worse, from the house where no one had lived for years and years, a beam of light shone.

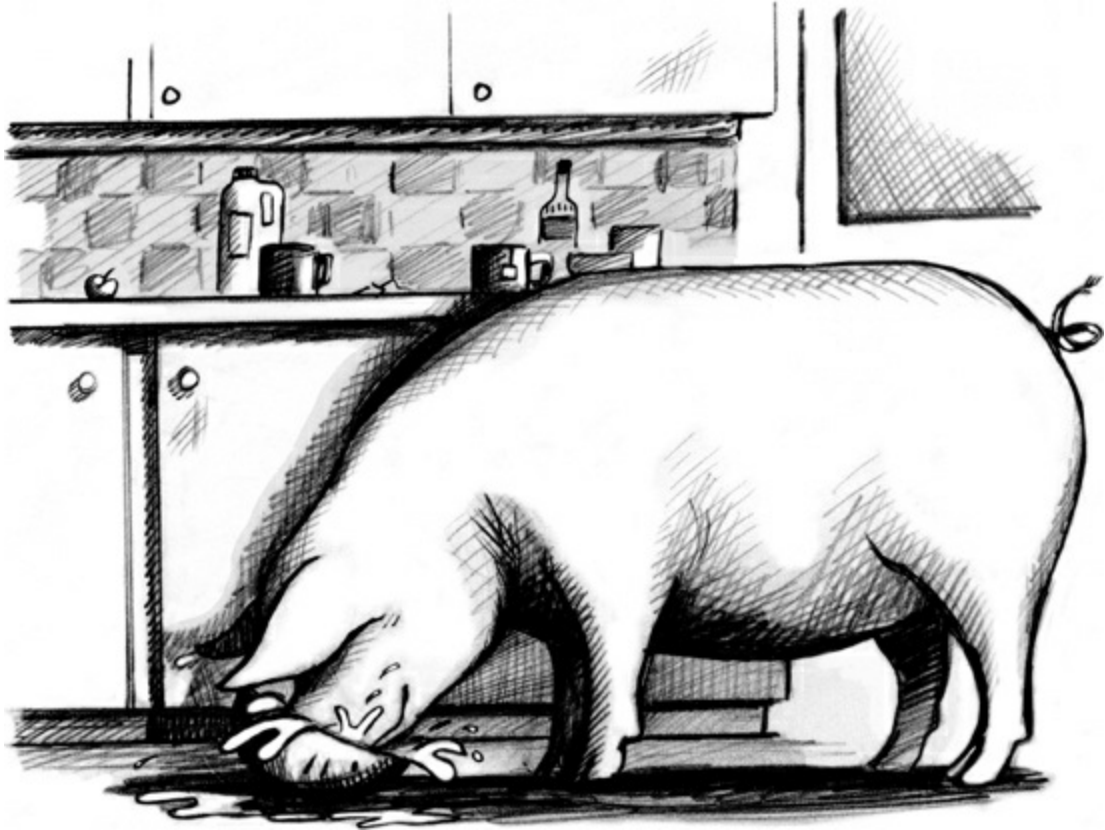
Somebody was home.



George looked back down the garden, at the path along which he'd come. He knew he should go back and get his parents. Even if he had to admit to his dad that he'd climbed through the fence into Next Door's garden, it would still be better than standing there all alone. He would just peek through the window to see if he could catch a glimpse of Freddy and then he would go and get his dad.

He edged closer to the beam of bright light coming from the empty house. It was a golden color, quite unlike the weak candlelight in his own house or the cold blue neon strips at school. Even though he was so scared his teeth had started to chatter, the light seemed to draw him forward until he was standing right by the window. He peered closer. Through the narrow space between the window frame and the blind, he could just see into the house. He could make out a kitchen, littered with mugs and old tea bags.

A sudden movement caught his eye and he squinted down at the kitchen floor, where he saw Freddy, his pig! He had his snout in a bowl and was slurping away, drinking his fill of some mysterious bright purple liquid.



George's blood ran cold—it was a terrible trick, he just *knew* it. “Yikes!” he shouted. “It’s poison.” He rapped sharply on the pane of glass. “*Don’t drink it, Freddy!*” he yelled.

But Freddy, who was a greedy pig, ignored his master’s voice and happily kept slurping up the contents of the bowl. Without stopping to think, George flew through the door and into the kitchen, where he grabbed the bowl from under Freddy’s snout and threw its contents into the sink. As the violet-colored liquid gurgled down the drain, he heard a voice behind him.

“Who,” it said, in distinct but childish tones, “are *you*?”

George whirled around. Standing behind him was a girl. She was wearing the most extraordinary costume, made of so many different colors and layers of flimsy fabric that it looked as though she had rolled herself in butterfly wings.

George spluttered. She might look strange, this girl with her long tangled blond hair and her blue-and-green feathery headdress, but she definitely wasn’t scary. “Who,” he replied indignantly, “do you think *you* are?”

“I asked first,” said the girl. “And anyway, this is *my* house. So I get to know who you are, but I don’t have to say anything if I don’t want to.”

“I’m George.” He stuck out his chin as he always did when he felt cross. “And that”—he pointed to Freddy—“is my pig. And you’ve kidnapped him.”

“I haven’t kidnapped your pig,” said the girl hotly. “How stupid. What would I want a pig for? I’m a ballerina and there aren’t any pigs in the ballet.”

“Huh, ballet,” muttered George darkly. His parents had made him take dance classes when he was younger, and he’d never forgotten the horror. “Anyway,” he retorted, “you’re not old enough to be a ballerina. You’re just a kid.”



“Actually, I’m in the corps de ballet,” said the girl snootily. “Which shows how much *you* know.”

“Well, if you’re so grown up, why were you trying to poison my pig?” demanded George.

“That’s not poison,” said the girl scornfully. “That’s grape soda.”

George, whose parents only ever gave him cloudy, pale, fresh-squeezed fruit juices, suddenly felt very silly for not realizing what the

purple stuff was.

“Well, this isn’t really your house, is it?” he continued, determined to get the better of her somehow. “It belongs to an old man with a long beard who disappeared years ago.”

“This *is* my house,” said the girl, her blue eyes flashing. “And I live here except when I’m dancing onstage.”

“Then where are your mom and dad?” demanded George.

“I don’t have any parents.” The girl’s pink lips stuck out in a pout. “I’m an orphan. I was found backstage wrapped up in a tutu. I’ve been adopted by the ballet. That’s why I’m such a talented dancer.” She sniffed loudly.

“Annie!” A man’s voice rang through the house. The girl stood very still.

“Annie!” They heard the voice again, coming closer. “Where are you, Annie?”

“Who’s that?” asked George suspiciously.

“That’s . . . uh . . . that’s . . .” She suddenly became very interested in her ballet shoes.

“Annie, there you are!” A tall man with messy dark hair and thick, heavy-framed glasses, set at a crooked angle on his nose, walked into the kitchen. “What have you been up to?”

“Oh!” The girl flashed him a brilliant smile. “I’ve just been giving the pig a drink of grape soda.”

A look of annoyance crossed the man’s face. “Annie,” he said patiently, “we’ve talked about this. There are times to make up stories. And there are times . . .” He trailed off as he caught sight of George standing in the corner and, next to him, a pig with purple stains around his snout and mouth that made him look as though he were smiling.

“Ah, a pig . . . in the kitchen . . . I see . . . ,” he said slowly, taking in the scene. “Sorry, Annie, I thought you were making things up again. Well, hello.” The man crossed the room to shake hands with George. Then he sort of patted the pig rather gingerly between the ears. “Hello . . . hi . . .” He seemed unsure what to say next.

“I’m George,” said George helpfully. “And this is my pig, Freddy.”

“Your pig,” the man echoed. He turned back to Annie, who shrugged and gave him an I-told-you-so look.

“I live next door,” George went on by way of explanation. “But my pig escaped through a hole in the fence, so I had to come and get him.”

“Of course!” The man smiled. “I was wondering how you got into the kitchen. My name is Eric—I’m Annie’s dad.” He pointed to the blond girl.

“Annie’s dad?” said George slyly, smiling at the girl. She stuck her nose up in the air and refused to meet his eye.

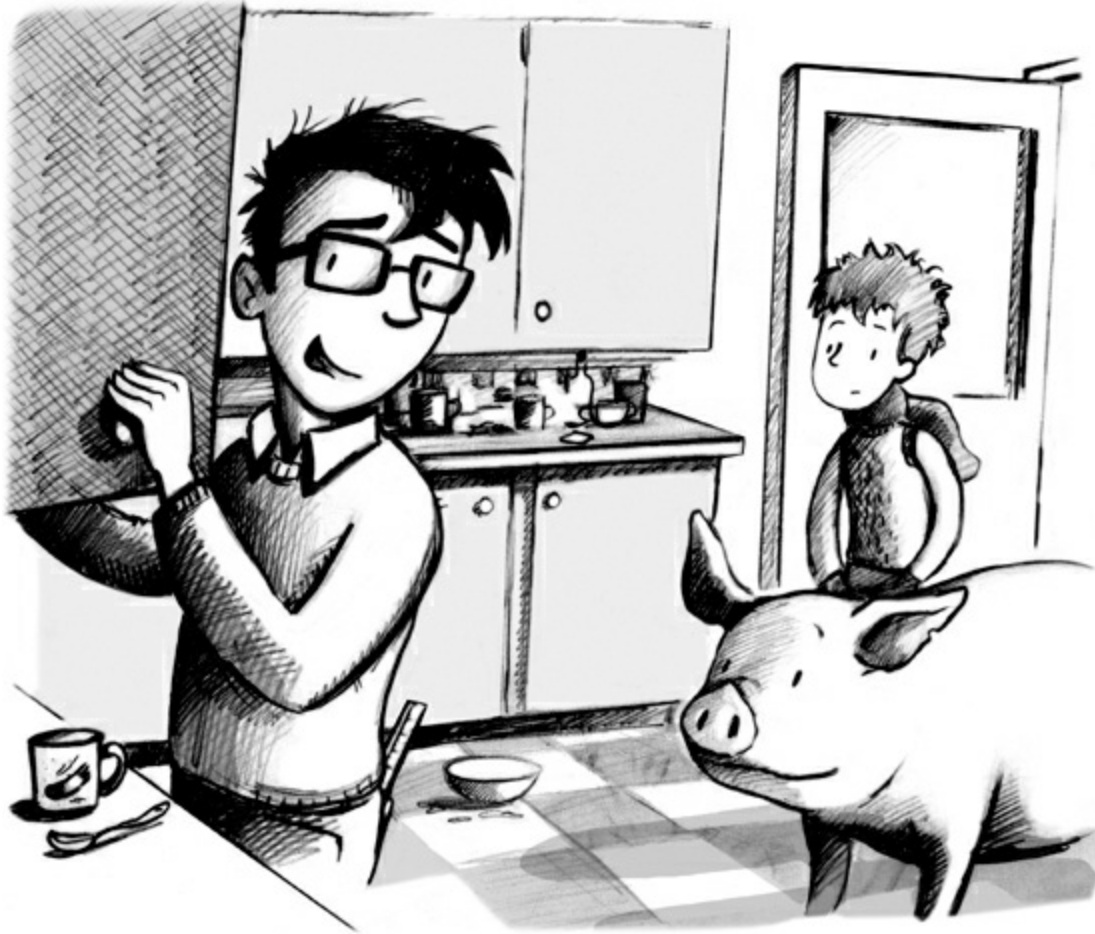
“We’re your new neighbors,” said Eric, gesturing around the kitchen, with its peeling wallpaper, moldy old tea bags, dripping faucets, and torn linoleum. “It’s a bit of a mess. We haven’t been here long. That’s why we haven’t met before.” Eric ruffled his dark hair and frowned. “Would you like something to drink? I gather Annie’s already given your pig something.”

“I’d love some grape soda,” said George quickly.

“None left,” said Annie, shaking her head. George’s face fell. It seemed very bad luck that even Freddy the pig should get to have nice drinks when he didn’t.

Eric opened a few cupboards in the kitchen, but they were all empty. He shrugged apologetically. “Glass of water?” he offered, pointing to the faucet.

George nodded. He wasn’t in a hurry to get home for his supper. Usually when he went to play with other kids, he went back to his own mom and dad feeling depressed by how peculiar they were. But this house seemed so odd that George felt quite cheerful. Finally he had found some people who were even odder than his own family. But just as he was thinking these happy thoughts, Eric went and spoiled it for him.



“It’s pretty dark,” he said, peering out of the window. “Do your parents know you’re here, George?” He picked up a telephone handset from the kitchen counter. “Let’s give them a call so they don’t worry about you.”

“Um . . . ,” said George awkwardly.

“What’s the number?” asked Eric, looking at him over the top of his glasses. “Or are they easier to reach on a cell phone?”

“They, um . . .” George could see no way out. “They don’t have any kind of phone,” he said in a rush.

“Why not?” said Annie, her blue eyes very round at the thought of not owning even a cell phone.

George squirmed a bit; both Annie and Eric were looking at him curiously, so he felt he had to explain. “They think technology is taking over the world,” he said very quickly. “And that we should try and live without it. They think that people—because of science and its discoveries—are polluting the planet with modern inventions.”

“Really?” Eric’s eyes sparkled behind his heavy glasses. “How very interesting.” At that moment the phone in his hand burst into tinkling song.

“Can I get it, can I get it? Pleasepleaseplease?” said Annie, grabbing the phone from him. “Mom!” And with a shriek of joy and a flounce of brightly colored costume, she shot out of the kitchen, phone clasped to her ear. “Guess what, Mom!” Her shrill voice rang out as she pattered along the hall corridor. “A strange boy came over . . .”

George went bright red with embarrassment.

“And he has a pig!” Annie’s voice carried perfectly back to the kitchen.

Eric peered at George and gently eased the kitchen door closed with his foot.

“And he’s never had grape soda!” Her fluting tones could still be heard through the shut door.

Eric turned on the faucet to get George a glass of water.

“And his parents don’t even have a phone!” Annie was fainter now, but they could still make out each painful word.

Eric flicked on the radio and music started playing. “So, George,” he said loudly, “where were we?”

“I don’t know,” whispered George, who could barely be heard in the din Eric had created in the kitchen to block out Annie’s telephone conversation.

Eric threw him a sympathetic glance. “Let me show you something fun,” he shouted, producing a plastic ruler from his pocket. He brandished it in front of George’s nose. “Do you know what this is?” he asked at top volume.

“A ruler?” said George. The answer seemed a bit too obvious.

“That’s right,” cried Eric, who was now rubbing the ruler against his hair. “Watch!” He held the ruler near the thin stream of water running from the faucet. As he did so, the stream of water bent in the air and flowed at an angle rather than straight down. Eric took the ruler away from the water and it ran down normally again. He gave the ruler to George, who rubbed it in his hair and put it close to the stream of water. The same thing happened.



“Is that magic?” yelled George with sudden excitement, completely distracted from Annie’s rudeness. “Are you a wizard?”

“Nope,” said Eric, putting the ruler back in his pocket as the water ran down in a long straight line once more. He turned off the faucet and switched off the radio. It was quiet now in the kitchen, and Annie could no longer be heard in the distance.

“That’s science, George,” said Eric, his whole face shining. “Science. The ruler steals electric charges from your hair when you rub the ruler through it. We can’t see the electric charges, but the stream of water can feel them.”

“Gosh, that’s amazing,” breathed George.

“It is,” agreed Eric. “Science is a wonderful and fascinating subject that helps us understand the world around us and all its marvels.”

“Are you a scientist?” asked George. He suddenly felt very confused.

“I am, yes,” replied Eric.

“Then how can that”—George pointed at the faucet—“be science when science is also killing the planet and everything on it? I don’t understand.”

“Ah, clever boy,” said Eric with a flourish. “You’ve gotten right to the heart of the matter. I will answer your question, but to do so, first I need to tell you a bit about science itself. *Science* is a big word. It means explaining the world around us using our senses, our intelligence, and our powers of observation.”



“Are you sure?” asked George doubtfully.

“Very sure,” said Eric. “There are many different types of natural science, and they have many different uses. The one I work with is all about the How and the Why. How did it all begin—the Universe, the Solar System, our planet, life on Earth? What was there before it began? Where did it all come from? And how does it all work? And why? This is physics, George, exciting, brilliant, and fascinating physics.”

“But that’s really interesting!” exclaimed George. Eric was talking about all the questions he pestered his parents with—the ones they could never answer. He tried asking these big questions at school, but the answer he got most often was that he’d find out in his classes the following year. That wasn’t really the answer he was after.

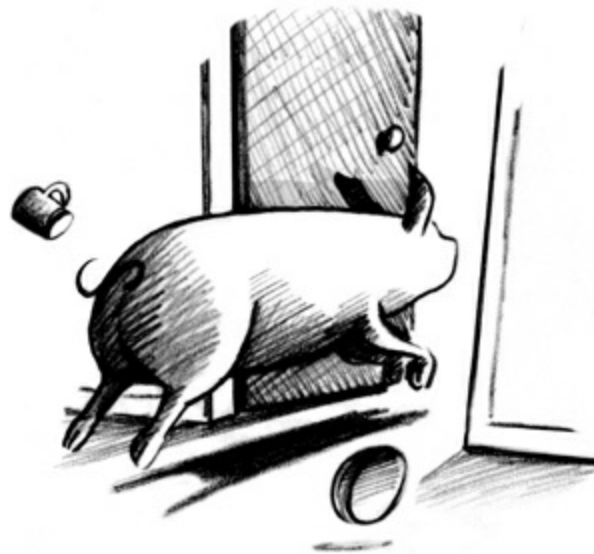
“Should I go on?” Eric asked him, his eyebrows raised.

George was just about to say “Oh, yes, please,” when Freddy, who had been quiet and docile up till then, seemed to pick up on his excitement. He lumbered upright and, with a surprising spurt of speed, he dashed forward, ears flattened, hooves flying, toward the door.

“*No-o-o-o-o!*” cried Eric, throwing himself after the pig, who had barged through the kitchen door.

“*Sto-o-o-op!*” shouted George, rushing into the next room behind them.

“Oink oink oink oink oink oink!” squealed Freddy, who was obviously enjoying his day out enormously.



Chapter Three

If George had thought the kitchen was untidy, then this next room was in a whole different dimension of messiness. It was filled with piles and piles of books, stacked up so high that some of the wobbly towers reached almost to the ceiling. As Freddy charged right through the middle of the room, notebooks, paperbacks, leather-bound tomes, and bits of paper flew up in a tornado around him.



“Catch him!” shouted Eric, who was trying to drive the pig back toward the kitchen.

“I’m trying!” George shouted back as he was batted in the face by a shiny-jacketed book.

“Hurry!” said Eric. “We must get him out of here.”

With a great leap, Annie’s dad hurled himself right onto Freddy’s back and grabbed his ears. Using them as a sort of steering wheel, he turned the pig—who was still moving at quite some speed—and rode him like a bucking bronco through the door and back into the kitchen.

Left alone, George looked around in wonder. He had never been in a room like this before. Not only was it beautifully, gloriously messy as all the papers flying about in the air came gently down to the ground, but it was also full of exciting objects.

On the wall, a huge blackboard covered with symbols and squiggles in colored chalk caught his eye. It also had lots of writing on it, but George didn't stop to read it. There were too many other things to look at. In the corner, a grandfather clock ticked slowly, the noise of the swinging pendulum clicking in time with a row of silvery balls suspended on very fine wire that seemed to be in perpetual motion. On a wooden stand was a long brass tube that pointed up toward the window. It looked old and beautiful, and George couldn't resist touching the metal, which felt cool and soft at the same time.

Eric walked back into the room with his shirt untucked, his hair standing on end, his glasses at a strange angle, and a huge smile on his face. In his hand he held a book, which he had caught while riding Freddy out of the room.



“George, this is incredible!” Eric looked thrilled. “I thought I’d lost it —it’s my new book! I couldn’t find it anywhere. And now your pig has found it for me! What a result!”

George just stood there, hand on the metal tube, staring at Eric openmouthed. He’d been expecting to get into trouble for the damage

his pig had wreaked. But Eric didn't even seem angry. He wasn't like anyone George had ever met—he never seemed to get angry, no matter what happened in his house. It was all very baffling.

“So I must thank you for all your help today,” continued the peculiar Eric, putting the lost book on top of a cardboard box.

“Help?” echoed George faintly, who couldn't quite believe what he was hearing.

“Yes, help,” said Eric firmly. “As you seem so interested in science, perhaps I could tell you a bit more about it, by way of a thank-you. Where shall we start? What would you like to know?”

George's mind was so full of questions that he found it hard to pick just one. Instead, he pointed at the metal tube. “What's this?” he asked.

“Good choice, George, good choice,” said Eric happily. “That's my telescope. It's a very old one—four hundred years ago, it belonged to a man called Galileo. He lived in Italy, and he loved looking up at the sky at night. At that time, people believed that all the planets in our Solar System went around the Earth—even the Sun, they thought, orbited our planet.”

“But I know that's not true,” said George, putting his eye to the old telescope. “I know that the Earth goes around the Sun.”

“You do now,” said Eric. “Science is also about gaining knowledge through experience—you know that fact because Galileo discovered it all those years ago. By looking through his telescope, he realized that the Earth and all the other planets in the Solar System orbit the Sun. Can you see anything?”

“I can see the Moon,” said George, squinting up the telescope, which was angled up to look out of the living room window into the evening sky. “It looks like it's smiling.”

“Those are scars from a violent past, the impacts of meteorites that crashed on the surface,” said Eric. “You can't see very far with Galileo's telescope, but if you went to an observatory and looked through a really big telescope, you would be able to see stars billions and billions of miles away—stars so far away that by the time their light reaches our planet, they may actually already be dead.”

“Can a star die? Really?” asked George.

“Oh yes,” said Eric. “But first I want to show you how a star is born,

and then we'll take a look at how it dies. Hang on a minute, George, while I get everything set up. I think you're going to like this."

OUR MOON



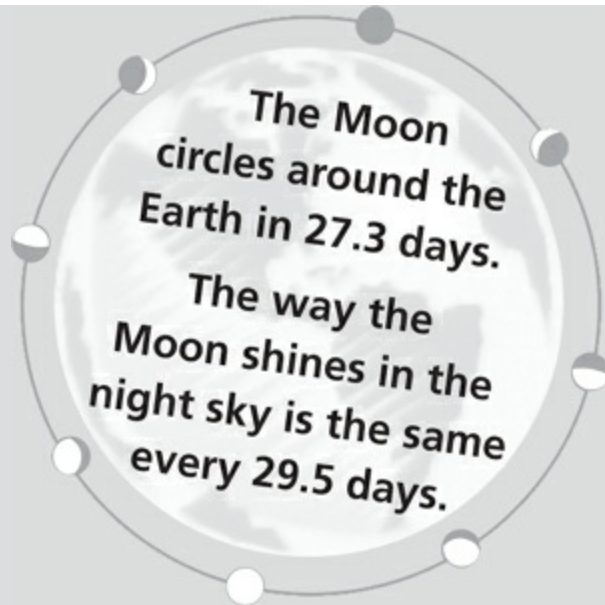
- 🌕 **A moon is a natural satellite of a planet.**
- 🌕 **A satellite is an object that goes around a planet—like the Earth, which goes around the Sun—and *natural* means that it is not man-made.**



← Average distance from the Earth: 238,854 miles (384,399 kilometers) →

Diameter: 2,160 miles (3,476 km), which is 27.3% of Earth's diameter **Surface area:** 0.074 × Earth's surface area **Volume:** 0.020 × Earth's volume **Mass:** 0.0123 × Earth's mass **Gravity at the equator:** 16.54% of Earth's gravity at Earth's equator

- 🌕 The most obvious effect the Moon's gravity has on the Earth is the tides of the oceans. The sea on the side of the Earth facing the Moon is pulled harder towards the Moon because it is closer. This raises a bulge in the sea on that side. Similarly, the sea on the side away from the Moon is pulled towards the Moon less than the Earth because it is farther away. This creates another bulge in the sea on the other side of the Earth.
- 🌕 Even though the Sun's gravitational pull is much stronger than the Moon's, it has only about half the Moon's effect on the tides because it is so much farther away. When the Moon is roughly in line with the Earth and the Sun, the Moon and the Sun tides combine to produce the large tides (called "spring tides") twice a month.



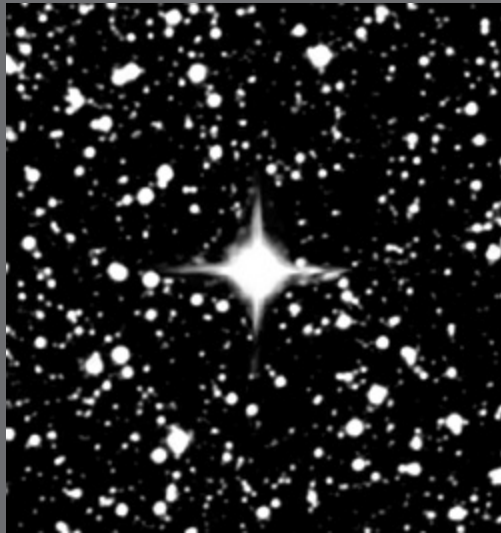
- There is no atmosphere on the Moon, so the sky there is black, even during the day. And there hasn't been an earthquake or a volcanic eruption there since around the time life began on Earth. So all living organisms that have ever been on the Earth have seen exactly the same features on the Moon.
- From Earth, we always see the same side of the Moon. The first pictures of the Moon's hidden side were taken by a spacecraft in 1959.

LIGHT & STARS



- ☆ Everything in our Universe takes time to travel, even light.
- ☆ In space, light always travels at the maximum speed that is possible: 186,000 miles per second (300,000 km per second). This speed is called the speed of light.
- ☆ It takes light only about 1.3 seconds to travel from Earth to the Moon.
- ☆ Our Sun is farther away from us than our Moon is. When light leaves the Sun, it takes about 8 minutes and 30 seconds to reach us on Earth.

- ★ The other stars in the sky are much, much farther away from Earth than the Sun. The closest one after the Sun is called Proxima Centauri, and it takes 4.22 years for light from it to reach Earth.
- ★ All other stars are even farther away. The light of almost all the stars we can see in the night sky has been traveling for hundreds, thousands, or even tens of thousands of years before reaching our eyes. Even though we see them, some of these stars may not exist anymore, but we do not know it yet because the light of their explosion when they die has yet to reach us.
- ★ Distances in space can be measured in terms of light-years, which is the distance light travels in one year. A light-year is almost 6,000 billion miles (around 9,500 billion km).



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IMAGES

Proxima Centauri, the closest star to the Earth after our Sun

The title "Chapter Four" is centered within a stylized graphic. The graphic consists of a large, light-colored star with eight points. Overlaid on the star are several concentric, hand-drawn circles and lines, resembling an atomic model or a celestial diagram. Small circles are placed at various points along these lines, suggesting orbits or particles. The text "Chapter Four" is written in a bold, sans-serif font across the middle of the star.

Chapter Four

Eric walked toward the doorway and stuck his head out into the hallway. “Ann-ie!” he shouted up the stairs.



“Ye-e-e-es,” her distant voice tinkled down to them.

“Do you want to come and see *The Birth and Death of a Star*?” called Eric.

“Seen it already,” she sang back. “Lots of times.” They heard her feet pattering down the stairs, and a second later she stuck her head around

the door. “Can I have some potato chips?”

“If we have any,” replied Eric. “And if we do, you’re to bring them into my library and share them with George. Okay?”

Annie smiled sweetly and disappeared into the kitchen. They heard the noise of cupboard doors being flung open.

“Don’t mind Annie,” said Eric gently, without looking at George. “She doesn’t mean any harm. She’s just . . .” He trailed off and went over to the far corner of the room, where he started fiddling around with a computer George hadn’t noticed before. He’d been too fascinated by the other objects to look at the flat silver screen with its keyboard attached. It was strange that George hadn’t spotted the computer right away—he really wished he could persuade his mom and dad to buy him one. He was saving up his allowance for a computer, but at the current rate, he calculated it was going to take him about eight years to afford even a really junky secondhand one. So instead, he had to use the clunky, slow, old machines at school, which crashed every five minutes and had sticky fingerprints all over the screen.



Eric’s computer was small and glossy. It looked powerful and neat—the sort of computer you might find on a spaceship. Eric hit a couple of buttons on the keyboard, and the computer made a sort of humming noise while bright flashes of color shot across the screen. He patted the computer happily.

“You have forgotten something,” said a strange mechanical voice. George jumped out of his skin.

“Have I?” Eric looked confused for a moment.

“Yes,” said the voice. “You have not introduced me.”

“I’m so sorry!” exclaimed Eric. “George, this is Cosmos, my computer.”

George gulped. He had no idea what to say.

“You have to say hello to Cosmos,” said Eric in a side whisper to George. “Otherwise he’ll get offended.”

“Hello, Cosmos,” said George nervously. He’d never spoken to a computer before, and he didn’t quite know where to look.

“Hello, George,” replied Cosmos. “Eric, you have forgotten something else.”

“What now?” said Eric.

“You have not told George I am the most powerful computer in the world.”

Eric rolled his eyes up to heaven. “George,” he said patiently, “Cosmos is the most powerful computer in the world.”

“That is correct,” agreed Cosmos. “I am. In the future, there will be computers more powerful than me. But there are none in the past or present.”

“Sorry about this,” Eric whispered to George. “Computers can be a bit touchy sometimes.”



“I am smarter than Eric, too,” boasted Cosmos.

“Says who?” said Eric crossly, glaring at the screen.

“Says me,” said Cosmos. “I can compute billions of numbers in a nanosecond. In less time than it takes you to say ‘Cosmos is great,’ I can compute the life of planets, of comets, of stars, and of galaxies. Before you can say ‘Cosmos is the most impressive computer that I have ever seen, he is truly incredible,’ I can—”

“All right, all right,” said Eric. “Cosmos, you are the most impressive computer we have ever seen. Now, can we move on? I want to show George how a star is born.”

“No,” said Cosmos.

“No?” said Eric. “What do you mean, *no*, you ridiculous machine?”

“I don’t want to,” said Cosmos snootily. “And I am not ridiculous. I am the most powerful computer that has ever been—”

“Oh, but *ple-e-ase*,” pleaded George, interrupting him. “Please, Cosmos, I really want to see how a star is born. *Please* won’t you show me?”

Cosmos was silent.

“Oh, come on, Cosmos,” said Eric. “Let’s show George some of the wonders of the Universe.”

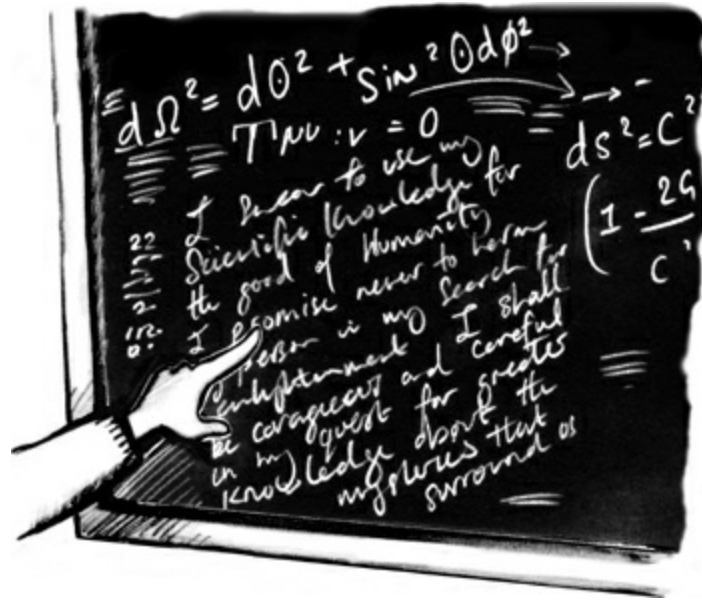
“Maybe,” replied Cosmos sulkily.

“George doesn’t have a very high opinion of science,” Eric went on. “So this is our chance, Cosmos, to show him the other side of science.”

“He must take the oath,” said Cosmos.

“Good point—smart Cosmos,” said Eric, leaping over to the blackboard.

George turned and studied the writing on it more closely. It looked like a poem.



“George,” said Eric, “do you want to learn about the greatest subject in the whole Universe?”

“Oh yes!” exclaimed George.

“Are you prepared to take a special oath to do so? To promise that you will use your knowledge only for good and not for evil?” Eric was staring at George intently from behind his big glasses. His voice had changed—he now sounded extremely serious. “This is very important, George. Science can be a force for good, but as you pointed out to me earlier, it can also do great harm.”

George stood up straighter and looked Eric in the eye. “I am,” he confirmed.

“Then,” said Eric, “look at the words on the blackboard. It is the Oath of the Scientist. If you agree with it, then read the oath out loud.”

George read what was written on the blackboard and thought about it for a moment. The words of the oath didn't frighten him. Instead they made him feel tingly with excitement, right down to his toes. He read the oath out loud, as Eric had instructed.

"I swear to use my scientific knowledge for the good of Humanity. I promise never to harm any person in my search for enlightenment . . ."

The living room door opened, and Annie sidled in, clutching a huge multipack bag of potato chips.

"Keep going," said Eric encouragingly. "You're doing very well."

George read out the next part.

"I shall be courageous and careful in my quest for greater knowledge about the mysteries that surround us. I shall not use scientific knowledge for my own personal gain or give it to those who seek to destroy the wonderful planet on which we live.

"If I break this oath, may the beauty and wonder of the Universe forever remain hidden from me."

Eric clapped. Annie burst an empty potato chip package. Cosmos flashed a rainbow of bright colors across his screen.

"Well done, George," said Eric. "You are now the second youngest member of the Order of Scientific Inquiry for the Good of Humanity."



“I salute you,” said Cosmos. “From now on, I will recognize your command.”

“And I’ll let you have some chips!” piped up Annie.

“Annie, shush!” said Eric. “We’re just getting to the good part. George, you may now use the secret key that unlocks the Universe.”

“Can I?” asked George. “Where is it?”

“Go over to Cosmos,” said Eric quietly, “and look at his keyboard. Can you guess which one you need to press? Can you figure out which one is the secret key that will unlock the Universe for you? Annie—say nothing!”

George did as he was told. Cosmos might be the world’s most powerful computer, but his keyboard was just an ordinary, familiar one, with the letters and symbols laid out in the same order as even the school’s crummiest computer. George thought hard. Which key would be the one to unlock the Universe for him? He looked again at the keyboard—and suddenly he knew.

“It’s this one, isn’t it?” he said to Eric, his finger hovering.

Eric nodded. “Press it, George. To begin.”

George’s finger came down on the key marked ENTER.

Suddenly the lights in the room started to fade . . .

“Welcome,” said Cosmos, playing a little computerized fanfare, “to the Universe.”



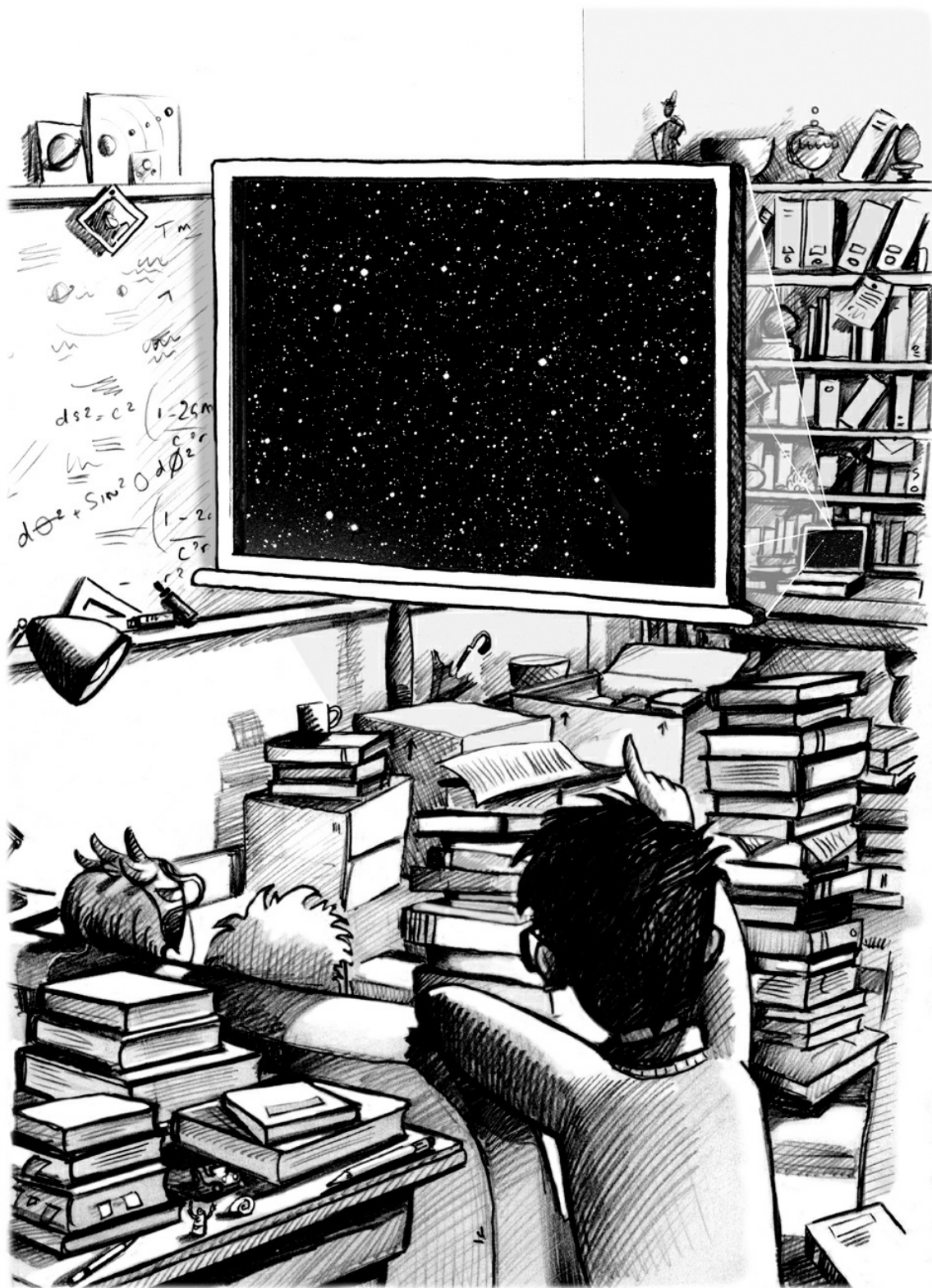


The room was getting darker and darker. “Come and sit here, George,” called Annie, who had already settled herself on the big comfy sofa. George sat down next to her, and after a few seconds he saw a tiny beam of very bright white light. It came directly from Cosmos’s screen. The beam shot out into the middle of the room, where it wavered for a second before it began to sketch a shape in the air. It moved from left to right in a straight line before dropping down toward the floor. Leaving a shining path of light behind it, it turned another corner to make three sides of a rectangle. One more right angle and the beam of light came back to its starting point. For a second, it looked like a flat shape hanging in the air, but suddenly it turned into something real and very familiar.

“But that looks like a—,” said George, who could suddenly see what it was.

“A window,” said Eric proudly. “Cosmos has made us a window on the Universe. Watch closely.”

The beam of light disappeared, leaving the window it had drawn in the middle of Eric’s living room, hanging in midair. Although the outline was still shining with bright light, it now looked exactly like a real window. It had a big sheet of glass in the pane and a metal frame. Beyond it, there was a view. And that view was not of Eric’s house, or of any house, road, or town, or anywhere else that George had ever seen before.



Instead, through the window George could see an incredible, vast darkness, peppered with what looked like tiny bright stars. He started to try and count them.

“George,” said Cosmos in his mechanical voice, “there are billions and billions of stars in the Universe. Unless you are as smart as me, you will not be able to count them all.”

“Cosmos, why are there so many?” asked George in wonder.

“New stars are created all the time,” answered the great computer. “They are born in giant clouds of dust and gas. I am going to show you how it happens.”

“How long does it take for a star to be born?” George asked.

“Tens of millions of years,” replied Cosmos. “I hope you are not in a hurry.”

“Tut-tut,” said Eric, sitting cross-legged on the floor beside the sofa, his long, thin limbs bent at sharp angles. He looked like a friendly giant spider. “Don’t worry, George, I’ve speeded it up quite a lot. You’ll still get home for dinner. Annie, pass the chips around. I don’t know about you, George, but the Universe always makes me very hungry.”

“Oh dear,” said Annie, sounding embarrassed. There was a rustling noise as she rooted around inside the big bag. “I’d better get some more.” She leaped off the sofa and dashed back to the kitchen.

As Annie left the room, George noticed something about the view through the window onto outer space: Not all of it was covered with little stars. In the bottom corner of the window he saw a patch of total darkness, a place where not a single star shone.

“What’s happening there?” He pointed.

“Let’s have a look, shall we?” said Eric. He pressed a button on a remote control, and the view through the window seemed to zoom toward the dark patch. As they got closer, George realized that an enormous cloud was hovering in that spot. The window kept moving forward until they were right inside the cloud itself, and George could see it was made of gas and dust, just as Cosmos had said.

“What is it?” he asked. “And where is it?”

“It’s a huge cloud in outer space, much bigger than the ones in the sky,” replied Eric, “made up of tiny, tiny particles that are all floating around inside it. There are so many of these particles that the cloud is

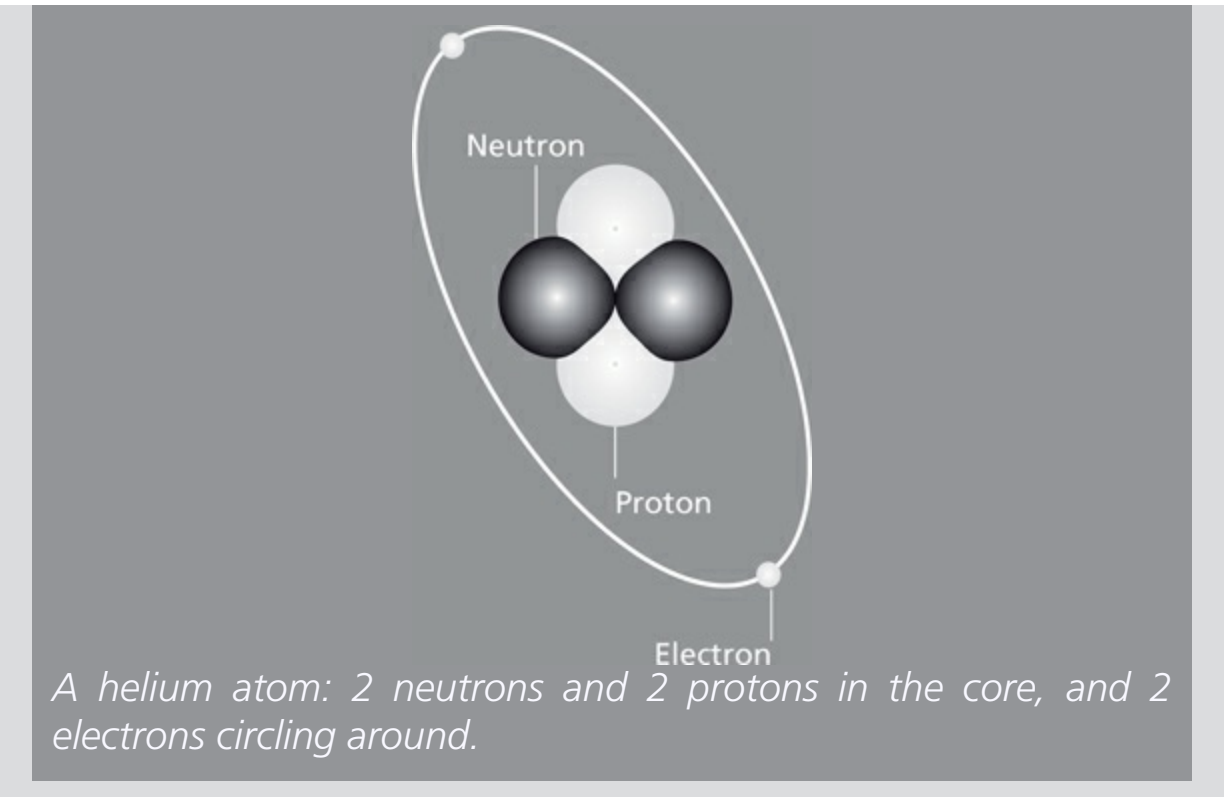
enormous—it's so big that you could put millions and millions of Earths inside it. From this cloud, many stars will be born.”

Inside the cloud, George could see the particles moving around, some joining together to form huge lumps of matter. These great lumps spun around and around, gathering even more particles all the time. But as the particles joined together, the spinning lumps weren't getting bigger; instead, they seemed to be getting smaller, as though something was squeezing them. It looked like someone was making gigantic dough balls in outer space. One of these giant balls was quite close to the window now, and George could see it spinning around, getting smaller and smaller all the time. As it shrank, it became hotter and hotter—so hot that George could feel the heat from where he sat on the sofa. And then it started to glow with a dim but frightening light.

PARTICLES



- ⊙ Elementary particles are the smallest possible things that cannot be divided up into smaller particles. Examples include the electron, which carries electricity, and the photon, which carries light.
- ⊙ An atom is not an elementary particle because it is made of electrons going around a nucleus in the center, like the planets go around the Sun. The nucleus is made of protons and neutrons packed tightly together.
- ⊙ Protons and neutrons were previously thought to be elementary particles, but we now know they are made of smaller particles called quarks, held together by gluons, which are the particles of a strong force that acts on quarks but not on electrons or photons.



“Why is it glowing?” asked George.

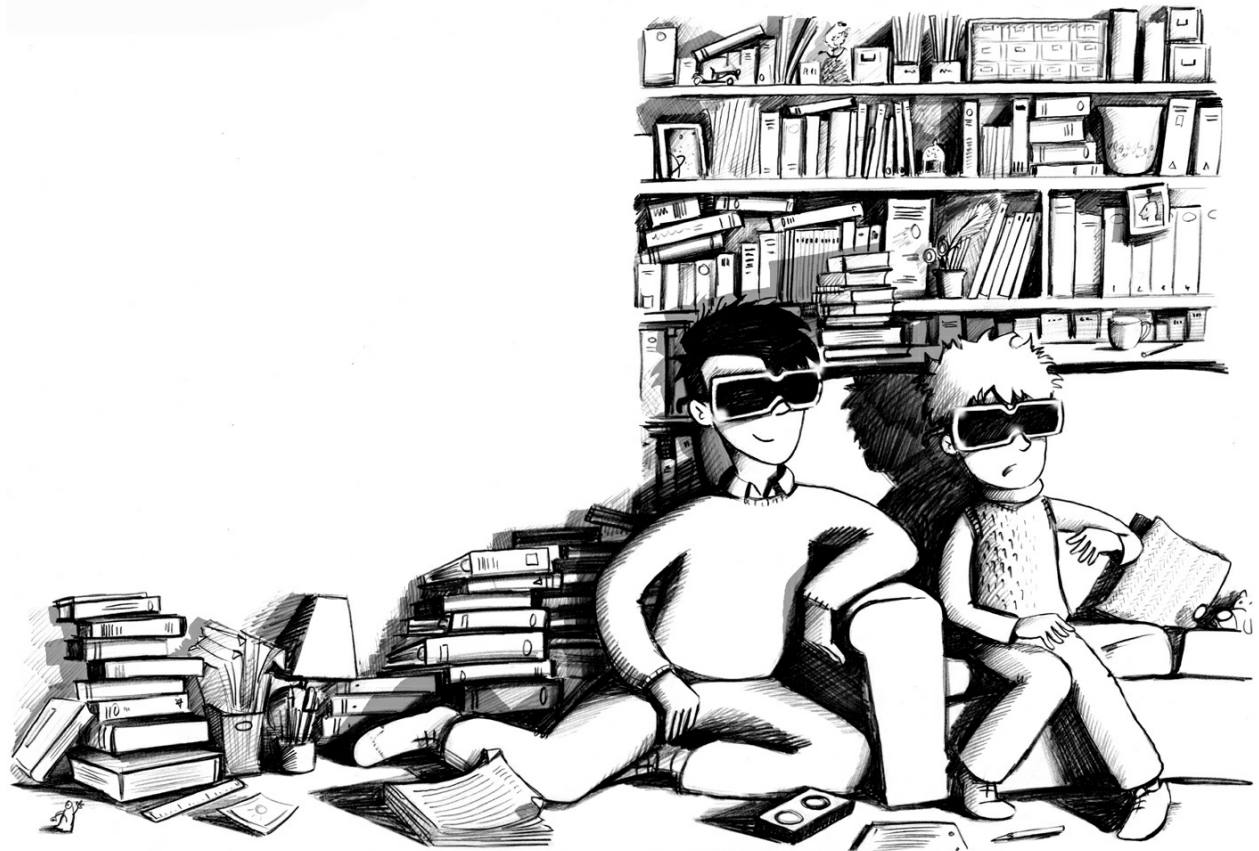
“The more it shrinks,” said Eric, “the hotter it gets. The hotter it gets, the brighter it shines. Very soon it’s going to get *too* hot.” He grabbed a couple of pairs of strange sunglasses from a pile of junk on the floor.

“Wear these,” he told George, putting on a pair himself. “It will soon be too bright for you to look at without glasses.”

Just as George put on the very dark glasses, the ball exploded from the inside, throwing off its outer layers of burning-hot gas in all directions. After the explosion, the ball was shining like the Sun.

“Wow!” said George. “Is that the Sun?”

“It could be,” Eric replied. “That’s how stars are born, and the Sun is a star. When a huge amount of gas and dust combines and shrinks to become dense and hot, as you’ve just seen, the particles in the middle of the ball are so pressed together they start to fuse or join up, releasing an enormous amount of energy. This is called a *nuclear fusion reaction*. It is so powerful that when it starts, it throws off the outer layers of the ball, and the rest is transformed into a star. That’s what you just saw.”



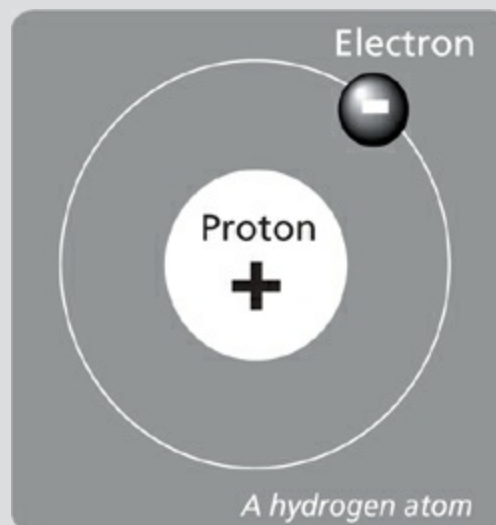
The star was now shining steadily in the distance. It was a beautiful sight. Without the special sunglasses, they wouldn't have been able to see much because the star was so bright.

George gazed at it, amazed by its power. Every now and then he could see huge jets of brightly shining gases sent hundreds of thousands of miles from the surface at extraordinary speeds.

MATTER



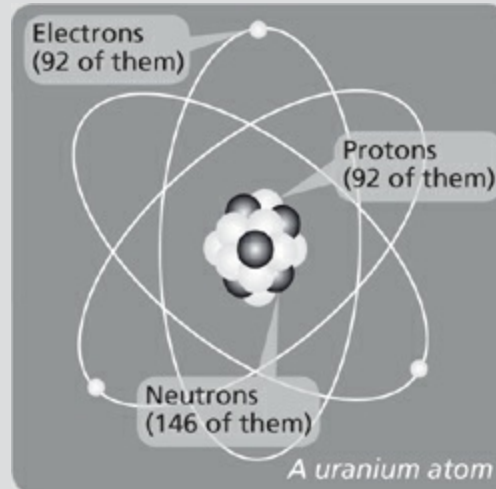
- Matter is made of atoms of various types. The type of atom, or element, as it is called, is determined by the number of protons in the nucleus. This can be up to 118, with mostly an equal or greater number of neutrons.
- The simplest atom is hydrogen, whose nucleus contains just one proton and no neutron.
- The largest naturally occurring atom, uranium, has a nucleus that contains 92 protons and 146 neutrons.



- Scientists think that 90% of the total number of all atoms in the Universe are hydrogen atoms.
- The remaining 10% are all the 117 other atoms, in various proportions. Some are extremely rare.
- When atoms join together in chains, the resulting object is called a molecule. There are countless molecules, of various sizes, and we

build new ones all the time in laboratories.

- Before stars are born, only the simplest molecules can be found in space. The most common is the hydrogen molecule, which is inside the huge clouds of gas in outer space where stars are born. It consists of two hydrogen atoms joined together.



“And the star will keep on shining like this forever?” he asked.

“Nothing is forever, George,” said Eric. “If stars shone forever, we wouldn’t be here. Inside their bellies, stars transform small particles into larger ones. That is what a nuclear fusion reaction does: It fuses small particles together, and builds big atoms out of small ones. The energy released by this fusion is enormous, and that’s what makes stars shine. Almost all the elements that you and I are made of were built inside stars that existed long before the Earth. So you could say that we are all the children of stars! When they exploded a long time ago, these stars sent into outer space all these large atoms they created. The same will happen to the star you are looking at now, behind the window. It will explode at the end of its life, when there are no more small particles available to fuse into bigger ones. The explosion will send into outer space all the large atoms the star created in its belly.”

On the other side of the window, the star was looking angry. Its bright yellow color was turning reddish as it grew and grew, until it was so big that it was almost impossible to see anything else through the window. It seemed to George that the star might explode at any moment. Eric pressed his remote control again, and the window immediately

moved away from the star, which kept getting redder and bigger all the time.

“Isn’t it amazing!” exclaimed Eric. “At first the ball shrinks and gives birth to a star, and then the star gets bigger and bigger! And now it is about to explode! Whatever you do, don’t take off your glasses.”

George watched the star in fascination. Suddenly, long after it had reached a size no one could have imagined, the most powerful explosion George had ever seen happened just in front of him. The whole star blew up, sending into outer space enormous quantities of light and red-hot gas, including all the new atoms it had created. After the explosion, George saw that all that was left of the star was a beautiful new cloud, full of extraordinary colors and new materials.



“Ooooh-ahhhh!” he said. It was like watching the most incredible fireworks display.

“You see,” said Eric, “with time, the colorful cloud you now see will mix with other clouds, ones from far distant stars that have also exploded. As they cool down, all the gases from these clouds will mix together into an even bigger cloud, where stars will be born again. Near where these new stars appear, the leftover elements will gather together to become objects of various sizes—but not ones big enough to become

stars themselves. Some of these objects will become balls, and with time, these balls will turn into planets. In real life, it takes a very long time for all this to happen—tens of millions of years!”

“Wow!” George was fascinated.

“But we haven’t got that much time to wait, and you need to get home for your supper,” said Eric, going over to Cosmos and pressing a few more keys. “So let me speed it up a bit. Here we go!”

In the blink of an eye, the tens of millions of years Eric was talking about had passed. The gas from the explosion of dozens of stars had gathered into an immense cloud. Within this cloud, new stars were appearing everywhere, until one formed just in front of the window. That star’s brightness made all the other stars very difficult to spot. Some distance away from this new star, the gas left over from the cloud was becoming very cold and had started to gather into small, icy rocks. George saw that one of these rocks was heading straight for the window. He opened his mouth to warn Eric, but the rock was traveling far too quickly. Before George could say anything, it smashed into the glass with a shattering, splintering roar, seeming to shake the whole house.

George jumped in fright and fell off the sofa. “What was *that*?” he shouted to Eric.

“Oops!” said Eric, who was typing away on Cosmos. “Sorry about that. I wasn’t expecting to take a direct hit.”

“You should be more careful,” said Cosmos crossly. “This isn’t the first time we’ve had an accident.”

“What was it?” asked George, who found he was clutching a small teddy bear that Annie must have left on the sofa. He was feeling rather dizzy.

“We were hit by a tiny comet,” admitted Eric, who was looking a little sheepish. “Sorry, everyone. I didn’t mean for that to happen.”

“A tiny what?” asked George, feeling the room spin around him.

Eric typed a few more commands into Cosmos. “I think that’s enough for today,” he said. “Are you all right, George?” He took off his glasses and peered into George’s face. “You look a little green.” He sounded worried. “Oh dear, I thought this was going to be fun. Annie!” he called into the kitchen. “Can you bring George a glass of water? Oh dear, oh dear.”



Annie came in, walking on tiptoe. She was carefully holding a very full teacup of water, some of which was sloshing over the side. Freddy the pig was glued to her side, casting adoring glances up at her with his piggy eyes. She held the cup out to George.

“Don’t worry,” she said kindly. “I felt really sick too, my first time. Dad”—it was a command—“it’s time to let George go home now. He’s had enough of the Universe.”

“Yes, yes, I think you’re right,” said Eric, still looking concerned.

“But it was so interesting!” protested George. “Can’t I see some more?”

“No, really, I think that’s enough,” said Eric hurriedly, putting on a coat. “I’m going to walk you back to your house now. Cosmos, you’re in charge of Annie for a couple of minutes. Come on, George, bring your pig.”

“Can I come back?” said George eagerly.

Eric stopped fussing around with coats and keys and outdoor shoes and smiled. “Certainly,” he said.

“But you must promise not to tell anyone about Cosmos,” Annie added.

“Is it a secret?” asked George, eagerly.

“Yes,” said Annie. “It’s a huge great big ginormous amazing secret that is a trillion gazillion times bigger than any secret you’ve ever heard before.”

“Now, Annie,” said Eric sternly, “I’ve told you that gazillion is not a real number. Say good-bye to George and his pig.”

Annie waved and gave George a smile.

“Good-bye, George,” said Cosmos’s voice. “Thank you for making use of my exceedingly powerful capacities.”

“Thank you, Cosmos,” said George politely.

With that, Eric ushered him and Freddy into the hallway and out of the front door and back to their real lives on planet Earth.

The title "Chapter Six" is centered within a stylized graphic. The graphic features a large, light-colored star with eight points. Overlaid on the star are several concentric, overlapping circles and lines, resembling an atomic model or a complex orbital diagram. The text "Chapter Six" is written in a bold, sans-serif font across the middle of the star.

Chapter Six

The next day at school, George couldn't stop thinking about the wonders he had seen at Eric's house. Enormous clouds and outer space and flying rocks! Cosmos, the world's most powerful computer! And they all lived next door to him, George, the boy whose parents wouldn't even let him have an ordinary computer in the house. The excitement was almost too much to bear, especially now that George was sitting once more at his very boring desk in the classroom.



He doodled on the schoolbook in front of him with his colored pencils, trying to sketch Eric's amazing computer—the one that could make a window from thin air, and through that window show you the birth and death of a star. But even though George could see it perfectly in his mind, his hand found it difficult to draw a picture that looked anything like what he had seen. It was very annoying. He had to keep crossing parts out and drawing them again, until the whole page looked like one giant squiggle.



“Ow!” he exclaimed suddenly as a missile made of a scrunched-up ball of paper hit him on the back of the head.

“Ah, George,” said Dr. Reeper, his teacher. “So, you are with us this afternoon after all. How nice.”

George looked up with a start. Dr. Reeper was standing right over him, staring down through his really smeared glasses. There was a large blue ink stain on his jacket, which reminded George of the shape of an exploding star.

“Do you have anything to say to the class?” said Dr. Reeper, peering down at George’s notebook, which George hastily tried to cover. “Other than ‘Ow!’ the only word I’ve heard you say today?”

“No, not really,” said George in a strangled, high-pitched voice.

“You wouldn’t like to say, ‘Dear Doctor Reeper, here is the homework I spent all weekend slaving over?’”

“Um, well . . . ,” said George, embarrassed.

“Or, ‘Doctor Reeper, I’ve listened carefully to every word you’ve ever said in class, written them all down, added my own comments, and here is my project, with which you will be extremely pleased’?”

“Uh . . . ,” muttered George, wondering how to get out of this one.

“Of course you wouldn’t,” said Dr. Reeper heavily. “After all, I’m just the teacher, and I stand here all day saying things for my own amusement and fun, with no hope that anyone will ever gain anything of value from my attempts to educate them.”

“I *do* listen,” protested George, who was now feeling guilty.

“Don’t try and flatter me,” said Dr. Reeper rather wildly. “It won’t work.” He whipped around sharply. “And give me that!” He shot across the classroom so fast he was almost a blur of speed and snatched a cell phone from a boy sitting at the back.

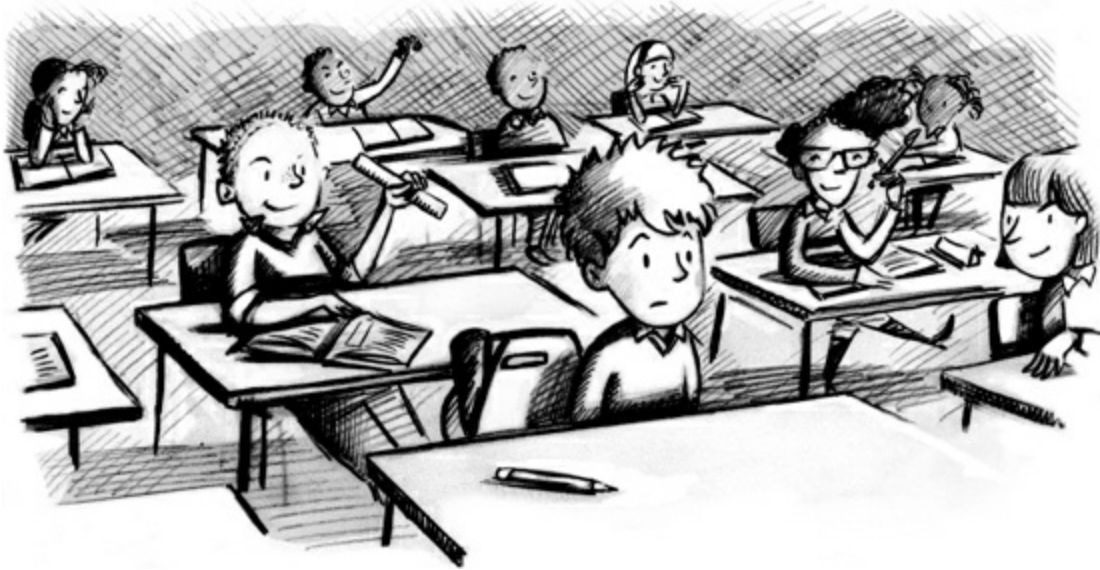
Dr. Reeper might wear tweed jackets and speak like a man from a century ago, but his pupils were so scared of him, they never tricked him the way they did teachers who were foolish enough to try and befriend them. He was a new teacher and he hadn’t been at the school long, but even on his first day he had quelled a whole room full of students into silence just by staring at them. There was nothing modern or touchy-feely or cozy about Dr. Reeper, with the result that his classrooms were always orderly, his homework came in on time, and even the slouchy rebel boys sat up straight and fell quiet when he walked into the room.

The kids called him “Greeper,” a nickname that came from the sign on his office door, which read DR. G. REEPER. Or “Greeper the Creeper” because of his mysterious habit of appearing without warning in far-flung corners of the school. There would be a gentle *swoosh* of thick-soled shoes and a faint smell of old tobacco, and before anyone knew it, Greeper would be bearing down on whatever secret mischief was brewing, rubbing his scarred hands with delight. No one knew how he had managed to cover both hands in red, scaly, painful-looking burn marks. And no one would ever dare ask.

“Perhaps, George,” said Greeper, pocketing the cell phone he had just confiscated, “you would care to enlighten the class as to what the artwork you have been working on this morning represents?”

“It’s, well, it’s . . . ,” whispered George, feeling his ears become hot and pink.

“Speak up, boy, speak up!” ordered Greeper. “We’re all curious to know quite what *this*”—he held up George’s drawing of Cosmos so the whole class could see—“is meant to be! Aren’t we, class?”



The other children snickered, delighted that Greeper was picking on someone who wasn’t them.

At that moment George really hated Greeper. He hated him so much he completely forgot his fear of shame or humiliation in front of the other pupils. Unfortunately he also forgot his promise to Eric.

“It’s a very special computer, actually,” he said in a loud voice, “which can show you what’s happening in the Universe. It belongs to my friend Eric.” He fixed Greeper with a very blue stare, his eyes determined under his tufts of dark red hair. “There are amazing things in outer space, just flying around all the time, like planets and stars and gold and stuff.” George was making the last part up—Eric hadn’t said anything about gold in outer space.



For the first time since George had been in Greeper's class, his teacher seemed lost for words. He just stood there, holding George's book in his hands, his jaw falling open as he looked at George in wonder.

"So it does work, after all," he half whispered to George. "And you've seen it. That's amazing . . ." A moment later it seemed as though Greeper were waking from a dream. He snapped George's book shut, handed it back to him, and walked to the front of the class.

"Now," said Greeper loudly, "given today's behavior, I'm going to assign one hundred lines. I want you to write neatly and clearly in your books: *I will not send text messages in Doctor Reeper's class because I am too busy listening to all the interesting things he has to say.* One hundred times, please, and anyone who hasn't finished by the time the bell rings can stay behind. Very good, get on with it."

There was an angry muttering from the classroom. George's classmates had been looking forward to seeing him being taken to pieces by the teacher, and instead, they'd all been punished for something quite different, and George had mostly been let off the hook.

"But, sir, that's not fair," whined a boy at the back.



“Neither is life,” said Greeper happily. “As that is one of the most useful lessons I could possibly teach you, I feel proud that you’ve understood it already. Carry on, class.” With that, he sat down at his desk, got out a book that was full of complicated equations, and starting flicking through the pages, nodding to himself wisely as he did so.

George felt a ruler being jabbed into his back.

“This is all your fault,” hissed Ringo, the class bully, who was sitting behind him.

“*Silence!*” thundered Greeper, without even looking up from his book. “Anyone who speaks will do *two* hundred lines instead.”

His hand whizzing across the page, George finished the one hundred lines in his neat writing just as the bell rang for the end of class. Carefully he tore out the page with the picture of Cosmos on it and folded it up, tucking it into a back pants pocket before dropping his book on Greeper’s desk. But George hadn’t taken even two steps down the hall before Greeper caught up with him and barred his way.

“George,” said Greeper very seriously, “this computer is real, isn’t it? You’ve seen it, haven’t you?” The look in his eyes was frightening.



“I was just, um, making it up,” said George quickly, trying to wriggle away. He wished he hadn’t said anything at all to Greeper.

“Where is it, George?” asked his teacher, speaking slowly and quietly. “It’s very important that you tell me where this amazing computer lives.”

“There *is* no computer,” said George, managing to duck under Greeper’s arm. “It doesn’t exist—I just imagined it, that’s all.”

Greeper drew back and looked at George thoughtfully. “Be careful, George,” he said in a scarily quiet voice. “Be very careful.” With that, he walked away.



The way home from school was long and hot; the unexpected heat of the early autumn sun was beating down on the asphalt, turning it soft and squishy under George's feet. He trudged along the pavement while big cars whizzed past him, leaving smelly fumes behind them as they went. In some of these enormous, shiny monsters sat the smug kids from school, watching DVDs in the backseat as their parents drove them home. Some of them made faces at George as they drove past, jeering at him for having to walk. Others waved happily, as though he would somehow be pleased to see them as they shot off into the distance in their vast gas-guzzlers. No one ever stopped and offered him a lift.

But today he didn't mind. He had plenty to think about on his walk home, and he felt glad to be alone. His mind was full of clouds in space, huge explosions, and the millions of years it took to make a star. These thoughts took him far, far across the Universe—so far, in fact, that he completely forgot an important fact about his life on planet Earth.

"Hey!" He heard a shout behind him, and it snapped him back to the here and now. He hoped it was just someone shouting in the street, a random noise that had nothing to do with him. He hurried along a little faster, clutching his school bag snugly to his chest.

"Hey!" He heard it again, this time a little closer. Resisting the urge to look back, he sped up his pace. On one side of him was the busy main road, on the other the city park, which offered nowhere to hide. The trees were too thin and straggly to stand behind, and going anywhere near the bushes was a bad idea. The last thing he wanted was to get dragged into them by the boys he feared were behind him. He kept going, getting faster every minute, his heartbeat thumping in his chest like a bongo drum.

“Georgie boy!” He heard the yell and his blood curdled. All his worst fears were confirmed. Usually when the end-of-school bell rang, George shot out of the gates and was well on his way home while the larger, slower boys were still flicking rubber bands at each other in the coatroom. He’d heard the awful stories of what Ringo and his followers did to the kids they caught on the street. Eyebrows shaved off, hung upside down, covered in mud, left up a tree wearing only underwear, painted in indelible ink, or abandoned to take the blame for broken windows—all were whispered tales at school of Ringo’s reign of terror.



But on that sunny, drowsy autumn afternoon, George had made a terrible mistake. He was walking home too slowly just when he’d given Ringo and his friends a reason to come looking for him. Angry with him for landing them with extra work in Greeper’s class, they were now clearly on his tail and ready to take revenge.



George looked around. Ahead of him he saw a group of mothers pushing carriages toward an intersection, where a crossing guard stopped the traffic to let people across. Scurrying forward, he joined the moms and babies, managing to insert himself into their midst so that he was surrounded by strollers. Ambling across the road while the crossing guard held up her bright yellow sign, George tried to look as though he belonged to one of the mother-and-baby groups. But he knew he wasn't fooling anyone. As he passed the crossing guard, she winked at him and said under her breath, "Don't worry, dear, I'll hold 'em back for you for a minute. But you run along home now. Don't let those nasty boys catch you."

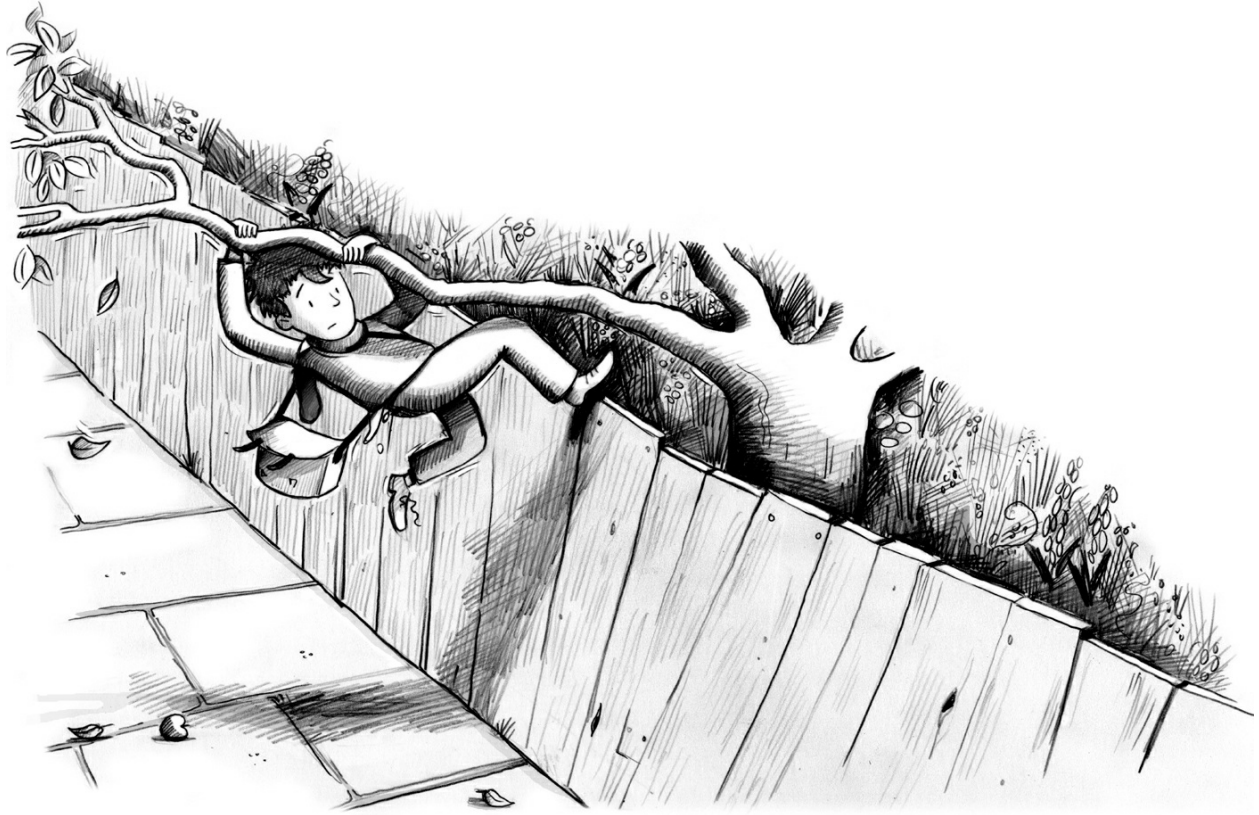
When George reached the other side of the road, to his surprise the crossing guard leaned her sign against a tree and stood there, glaring back at Ringo and his friends. The roar of the traffic started up again, and as George sped away he heard another menacing shout.

“Hey! We gotta get across—we need to get home and do our . . . schoolwork If you don’t let us cross, I’ll tell my mother and she’ll come and straighten you out.”

“You watch yourself, Richard Bright,” grumbled the crossing guard, walking slowly out into the road with her sign.

George turned off the main road, but the sound of heavy thudding feet behind told him they knew which way he’d gone. He was hurrying down a long tree-lined alley that ran behind the gardens of some very big houses; for once it was empty of adults who might have saved him.

George tried a few of the doors in the fences, but they were all firmly locked. He looked around in a panic and then had a flash of inspiration. Grabbing on to the lowest bough of an overhanging apple tree, he hoisted himself up high enough to gain a foothold on the top of the fence and leaped right over it. He landed in a large prickly bush, which scratched him, ripping his school uniform. As he lay groaning silently in the shrubbery, he heard Ringo and his friends pass by on the other side of the fence, making spine-chilling comments about what they’d do to George when they got their hands on him.



George stayed still until he was sure they'd gone. Wriggling free of his school sweater, which was hopelessly tangled in the spiky bush, he struggled out of the clinging branches. His pants pockets had emptied their contents onto the ground. He scrabbled around, trying to pick up all his important things. Then he emerged from the undergrowth onto a long, flat green lawn, where a very surprised lady lay in a deck chair, sunbathing. She lifted up her dark glasses and looked at him.

"*Bonjour!*" she said in a nice voice. She pointed toward the house. "Go zat way—ze gate is not so locked."

"Oh, *merci*," said George, remembering his one word of French. "And, um, sorry," he added as he rushed past her and ran along a passage by the side of her house. He went through the gate, came out onto the road, and set off for home, limping a little because he'd twisted his left foot. The streets were quiet and sleepy as he hobbled along. But the silence didn't last long.

"There he is!" A great cry went up. "*Georgie-boy!*" he heard. "*We're coming to get you!*"

George gathered the last of his strength and tried to get his legs to move fast, but he felt as though he were wading through quicksand. He wasn't far from home—he could see the end of his road—but Ringo and his gang were gaining on him. He plowed bravely forward, reaching the corner just as he thought he might collapse on the pavement.

"*We're gonna kill you!*" Ringo shouted from behind him.

Staggering, George tottered down his street. His breathing had gone all funny—the air was going in and out of his lungs in great swooshing gasps. All the scratches and bruises and bumps he'd gotten running away from Ringo were hurting, his throat was parched, and he was exhausted. He couldn't have gone much farther, but he didn't need to—he was home. He'd reached the green front door without being turned into ground meat, or something worse, by Ringo and his terrible friends, and now everything was going to be all right. All he had to do was reach into his pocket and find his key to unlock the front door.

But it wasn't there.



He turned out his pockets and found all his treasures—a marble, a Spanish coin, a length of string, a model red sports car, and a ball of fluff. But no key. He must have dropped it in the bushes when he climbed over the fence. He rang the bell, hoping his mom might have come home early. *Ting-a-ling-ling-ling!* He tried again. But there was still no answer.

Seeing him standing there, Ringo realized he'd won. He plastered a hideous smile on his face and started to saunter confidently toward George. Behind him, eager for trouble, came his three weasel-faced, hard-knuckled friends.

George knew there was nowhere left to run. He closed his eyes and stood with his back to his front door, his stomach churning as he prepared to meet his fate. He tried to think of something to say that might make Ringo back off. But he couldn't come up with anything clever, and there wasn't much point in telling Ringo he was going to get

into trouble. Ringo knew that already, and it had never stopped him before. The footsteps stopped, and George opened one eye to see what was happening. Ringo and his friends had paused halfway down the path and were having some kind of conference about what to do with George.

“No!” Ringo was saying loudly. “That’s ridiculous! Let’s squeeze him against the wall until he begs us to let him go!”

But just as Ringo spoke, something happened. Something so peculiar that, afterward, Ringo and his friends weren’t sure if they’d dreamed it. The door of the house next to George’s flew open and out of it bounded what looked like a tiny astronaut. Everyone took a step back in astonishment as the small figure in a white spacesuit with a round glass helmet and an antenna attached to the back jumped into the middle of the road, striking a fierce, karate-style pose.

“Get back,” said the spacesuit in a strange metallic voice, “or I will put the curse of Alien Life on you. You will turn green, and your brains will bubble and leak out of your ears and down your nose. Your bones will turn to rubber, and you will grow hundreds of warts all over your body. You will only be able to eat spinach and broccoli, and you will never, ever be able to watch television again because it will make your eyes fall out of your head. So there!” The astronaut did a few twirls and kicks that looked somehow familiar to George.



Ringo and his friends had turned a ghostly color and were stumbling backward, their mouths hanging open. They were absolutely terrified.

“Get into the house,” said the spacesuit to George.

George slipped into Next Door’s house. He wasn’t scared of the little astronaut—he’d caught a gleam of bright blond hair through the glass of the helmet. It looked like Annie had saved him.



“Phew!” The figure in the space suit followed George into the house, slamming the front door with a backward kick of a hefty space boot. “It’s hot in here,” it added, pulling off the round glass helmet and flipping out a long ponytail. It was Annie, a bit pink in the face from jumping about in the heavy suit. “Did you see how scared they were?” she said to George, beaming and wiping her forehead on her sleeve. “Did you?” She strode along the hallway, making clunking noises as she walked. “Come on.”

“Um, yes. Thank you,” George managed to say as he trailed behind her into the same room where he’d watched *The Birth and Death of a Star* with Eric. He’d been so excited about coming back to see Cosmos again, but now he just felt miserable. He’d accidentally told horrible Dr. Reeper about Cosmos, when he’d promised Eric he would keep it a secret. He’d had a long, frightening journey back from school being chased by the bullies, and to cap it all off, he’d been rescued by a little girl wearing a space suit. It was turning out to be a really bad day.



Annie, on the other hand, seemed to be enjoying herself immensely. “What do you think?” she said to George, smoothing down the brilliant white folds of her jumpsuit. “It’s new—it just arrived in the mail.” On the floor lay a cardboard box covered in stamps, marked SPACE ADVENTURES R US! Next to it was a much smaller pink suit with sequins, badges, and ribbons sewn all over it. It was dirty and worn and covered in patches. “That’s my old suit,” Annie explained. “I had that when I was really young,” she said scornfully. “I thought it was cool to put all that stuff on it, but now I like my space suits plain.”

“Why have you got a space suit?” asked George. “Are you going to a costume party?”

“As if!” Annie rolled her eyes. “Cosmos!” she called.

“Yes, Annie,” said Cosmos the computer fondly.

“You good, beautiful, lovely, wonderful computer!”

“Oh, Annie!” said Cosmos, his screen glowing as if he were blushing.

“George wants to know why I have a space suit.”

“Annie has a space suit,” replied Cosmos, “so she can go on journeys around outer space. It is very cold out there, around minus four hundred and fifty-five degrees Fahrenheit. She would freeze solid in a fraction of a second if she didn’t wear it.”

TEMPERATURE



- ⚡ Average temperature on Earth's surface: 59 degrees Fahrenheit (15 degrees Celsius)
- ⚡ Lowest temperature ever recorded on Earth: -128.2°F (-89°C), Vostok, Antarctica, July 21, 1983
- ⚡ Highest temperature ever recorded on Earth: 136.4°F (58°C), Al 'Aziziyah, Libya, September 13, 1922
- ⚡ Temperature on the surface of the Moon:
Daytime average: 230°F (110°C)
Nighttime average: -240°F (-150°C)
- ⚡ Average temperature on the surface of the Sun: $9,932^{\circ}\text{F}$ ($5,500^{\circ}\text{C}$)
- ⚡ Average temperature at the core of the Sun: $27,000,000^{\circ}\text{F}$ ($15,000,000^{\circ}\text{C}$)
- ⚡ Average temperature of space: -454.72°F (-270.4°C)



“Yeah, but—,” protested George. But he didn’t get far.

“I go on journeys around the Solar System with my dad,” boasted Annie. “Sometimes my mom comes too, but she doesn’t really like it in outer space.”

George felt really fed up. He was in no mood for silly games. “No you don’t,” he said crossly. “You don’t go into outer space. You’d have to go up in the space shuttle to do that, and they’re never going to let you on board because they wouldn’t know what was true and what you’d made up.”

Annie’s mouth had formed a perfect O.

“You just tell stupid stories about being a ballerina or an astronaut, and your dad and Cosmos pretend to believe you, but they don’t really,” continued George, who was hot and tired and wanted to have something good to eat.

Annie blinked rapidly. Her blue eyes were suddenly very shiny and full of tears. “I’m not making it up,” she said furiously, her round cheeks turning even pinker. “I’m not, I’m not. It’s all true, I don’t tell stories. I *am* a ballerina, and I *do* go into outer space, and I’m going to show you.” She stomped over to Cosmos. “And,” she went on angrily, “you’re going to come too. And that way you’ll believe me.” She rummaged in a shipping box and brought out another suit, which she threw at George. “Put that on,” she commanded.

“Uh-oh,” said Cosmos quietly.

Annie was standing in front of Cosmos, drumming her fingers on the keyboard. “Where should I take him?” she asked.

“I don’t think this is a good idea,” warned Cosmos. “What will your dad say?”

“He won’t know,” said Annie quickly. “We’ll just go and come right back. It’ll take two minutes. Please, Cosmos!” she pleaded, her eyes now brimming over with tears. “Everyone thinks I make everything up and I don’t! It’s true about the Solar System, and I want to show George so he doesn’t think I tell lies.”



“All right, all right,” said Cosmos hastily. “Please don’t drop saltwater on my keyboard; it rusts my insides. But you can just look. I don’t want either of you actually to go out there.”

Annie wheeled around to face George. Her face was fierce, but the tears were still flowing. “What do you want to see?” she demanded. “What’s the most interesting thing in the Universe?”

George thought hard. He had no idea what was going on, but he certainly hadn’t meant to upset Annie so much. He didn’t like seeing her cry, and now he felt even worse about Eric. Eric had said to him only yesterday that Annie didn’t mean any harm, and yet George had been pretty nasty to her. Perhaps, he thought, it would be better to play along.

“Comets,” he said, remembering the end of *The Birth and Death of a Star* and the rock that had smashed into the window. “I think comets are the most interesting things in the Universe.”

Annie typed the word *comet* on Cosmos’s keyboard.

“Put on your suit, George, quickly!” she ordered. “It’s about to get cold.” With that, she hit the button marked ENTER . . .





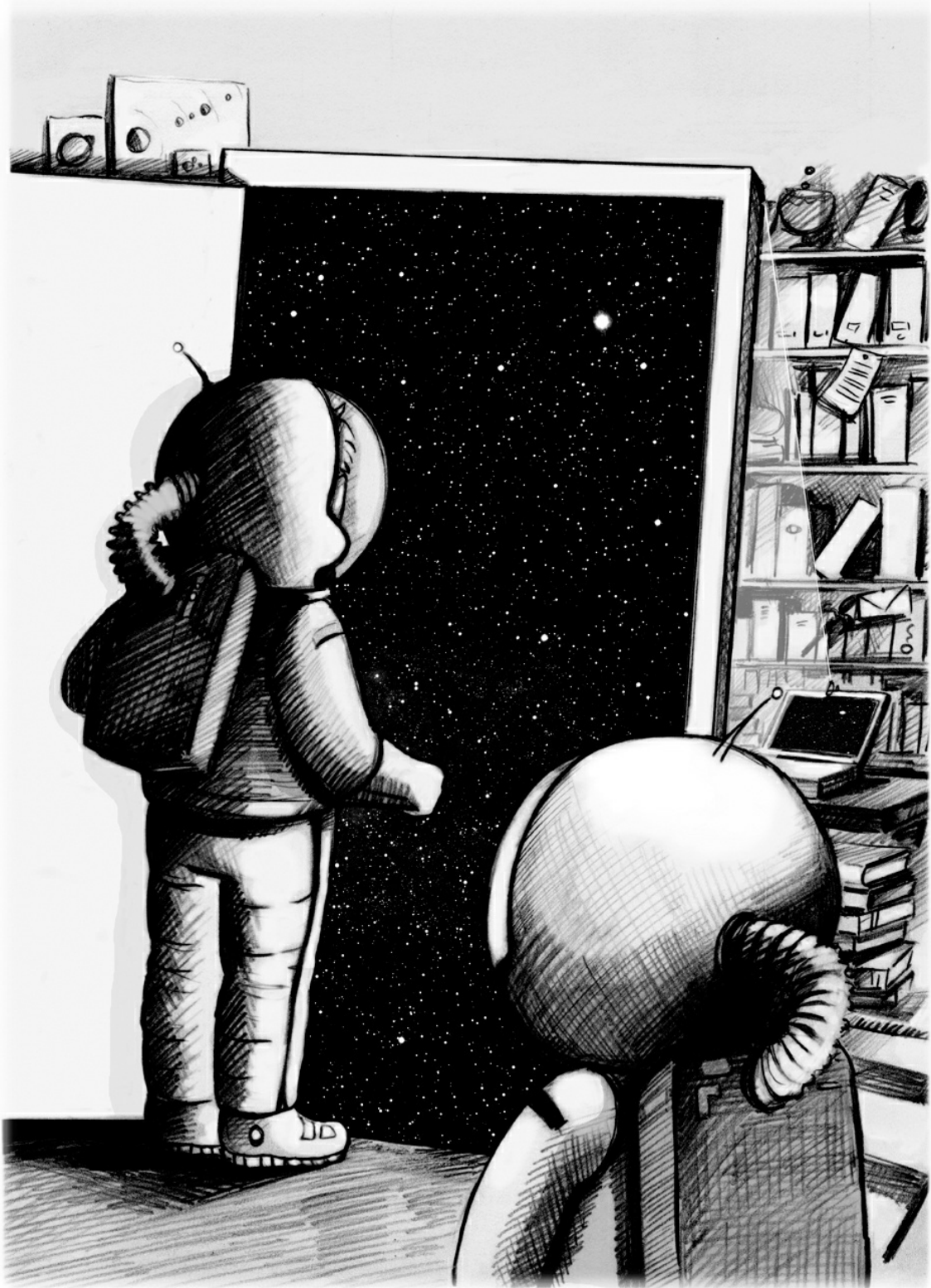
Once more everything went dark. The little beam of brilliant light shot out from Cosmos's screen into the middle of the room, hovered for a second, and then started to draw a shape. Only this time it wasn't making a window out of thin air. It was drawing something different. The beam drew a line up from the floor, then turned left, kept going in a straight line, and dropped back down to the floor again.

"Oh, look!" said George, who could see what it was now. "Cosmos has drawn a door!"

"I haven't just drawn it," said Cosmos huffily. "I'm much smarter than that, you know. I've *made* you a doorway. It's a portal. It leads to —"

"Shush, Cosmos!" said Annie. She had put on her helmet again and was speaking through the voice transmitter fitted inside it. It gave her the same funny voice that had so frightened Ringo and his friends. "Let George open it himself."

By now George had struggled into the big, heavy white suit and glass helmet that Annie had chucked at him. Attached to the back of the suit was a small tank that fed air through a tube into the helmet so he could breathe easily inside it. He put on the big space boots and gloves that Annie had thrown at him, and then he stepped forward and gave the door a timid push. It flew open, revealing an enormous expanse filled with hundreds of little lights that turned out to be stars. One in particular was much bigger and brighter than the others.



“Wow!” said George, speaking through his own voice transmitter. When he’d watched *The Birth and Death of a Star*, he’d seen the events in outer space through a windowpane. But this time there didn’t seem to be anything between him and outer space. It looked as though he could just step through the doorway and be there. But where? If he took that small step, where would he be?

“Where . . . ? What . . . ? How . . . ?” said George in wonder.

“See that bright star over there, the brightest star of all those you can see?” George heard Cosmos reply. “It’s the Sun. Our Sun. It looks smaller from here than when you look at it in the sky. The doorway leads to a place in the Solar System that is much farther away from the Sun than planet Earth. There is a large comet coming—that is why I have selected this location for you. You will see it in a few minutes. Please stand back from the door.”

George took a step backward. But Annie, who was right next to him, grabbed his suit and hauled him forward again.

“Please stand back from the door, a comet is approaching,” said Cosmos as though he were announcing the arrival of a train at the station. “Please do not stand too close to the edge—the comet will be traveling at high speed.”

Annie nudged George and pointed at the doorway with her foot.

“Please stand back from the door,” repeated Cosmos.

“When I count to three . . . ,” said Annie. “One.” She held up one finger. Beyond the door, George could see a large rock coming toward them, much larger than the tiny one that hit the window the day before.

“This comet will not be stopping,” continued Cosmos. “It goes straight through our Solar System.”

Annie held up another finger to indicate “Two.” The grayish white rock was getting closer.

“The journey time is approximately one hundred and eighty-four years,” said Cosmos. “Calling at Saturn, Jupiter, Mars, Earth, and the Sun. On its way back, it will also call at Neptune and Pluto, now out of service as a planet.”

“Please, my wonderful Cosmos, when we’re out there on the comet, can you accelerate the journey? Otherwise it will take us months to see

the planets!” Without waiting for Cosmos to reply, Annie shouted, “*Three!*” grabbed George’s hand, and dragged him through the doorway.

PLUTO



- Before August 2006 there were said to be nine planets that revolved around the Sun: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. These nine celestial bodies still exist, of course, and are exactly the same as they were before, but in August 2006 the International Astronomical Union decided not to call Pluto a planet anymore. It is now called a dwarf planet.
- **This is due to a change in the definition of what a planet is. There now are three rules that need to be fulfilled by any object in space in order for it to be called a planet:**
 - 1) It has to be in orbit around the Sun.
 - 2) It has to be big enough for gravity to make it almost round and stay that way.
 - 3) Its gravity has to have attracted almost everything that is next to it in space as it travels around the Sun, so that its path is cleared.
- According to this new definition, Pluto is not a planet anymore. Is it in orbit around the Sun? Yes. Is it almost round and will it stay so? Yes. Has it cleared its path around the Sun? No. There are lots of rocks in its orbital path. So, because it failed to fulfill the third rule, Pluto has been downgraded from a planet to a dwarf planet.
- The other eight planets fulfill the three rules and so they remain planets. For planets and stars other than the Sun, an additional requirement has been agreed upon by the International Astronomical Union: The object should not be so big as to become a star itself at a later stage.

- Planets around stars other than the Sun are called exoplanets. So far, over 240 exoplanets have been seen. Most of them are huge—much bigger than the Earth.
- In December 2006 a satellite named *Corot* was sent into space. The quality of the detectors *Corot* is equipped with should allow for the discovery of exoplanets much smaller than before, down to about twice the size of the Earth. One such planet was detected using other means in 2007. It is called Gliese 581 c.

The last thing he heard was Cosmos's voice, calling as though from millions and millions of miles away, "Don't jump! It isn't safe! Come *ba-a-a-ack*."

And then there was silence.

The title "Chapter Ten" is centered within a stylized graphic. The graphic consists of a large, light-colored star with eight points. Overlaid on the star are several concentric, slightly irregular circles. Small, shaded spheres are positioned at various points where the circles intersect, resembling an atomic model or a molecular structure. The text "Chapter Ten" is written in a bold, sans-serif font across the center of the star.

Chapter Ten

Out in the street, Ringo and his friends were still standing there, as though stuck to the pavement by some invisible force.

“What was that?” asked a small, skinny boy who went by the name of Whippet.

“Dunno,” said the huge boy they called Tank, scratching his head.

“Well, *I* wasn’t scared,” said Ringo defiantly.

“Neither was I,” chorused all the others quickly.



“I was just going to have a word with that weirdo in the space suit when it got frightened and ran away.”

“Yeah, yeah, yeah,” his friends all agreed quickly. “Course you were, Ringo. Course you were.”

“So I think,” Ringo went on, “*you*”—he pointed at the newest member of his gang—“should ring the doorbell.”

“Me?” The boy gulped.

“You said you weren’t scared,” said Ringo.

“I’m not!” he squeaked.

“Then you can ring the bell, can’t you?”

“Why can’t you do it?” asked the new boy.

“Because I asked you first. Go on.” Ringo glared at the boy. “Do you wanna be part of this gang?”

“Yes!” said the boy, wondering which was worse—meeting a spaceman and suffering the curse of Alien Life or making Ringo angry. He settled for the spaceman—at least he wouldn’t have to see him every day at school. He edged toward Eric’s front door uneasily.

“Then ring the bell, Zit,” said Ringo, “or you’ll be an *ex*-member of this gang.”

“Okay,” muttered Zit, who didn’t like his special new gang name much either. The others all took a few steps backward.

The new boy’s finger hovered over the bell.

“Ringo,” said one of the others suddenly, “what’re we gonna do if he opens the door?”

“*What’re we gonna do if he opens the door?*” Ringo echoed the question while he tried to think of an answer. He lookayed up at the sky as though searching for an idea. “We’re gonna—” Even Ringo wasn’t being his usual confident, thuggish self. But before he could come up with an answer, he let out a shout of pain. “Arrrrggghhhh!” he yelped as a hand grabbed him by the ear and twisted it very hard.

“What,” said a stern voice, “are you boys doing, hanging around in the street?” It was Dr. Reeper—Ringo and George’s class teacher from school. He had Ringo firmly by the ear and clearly didn’t intend to let go. The boys were very startled to see a teacher outside the school grounds—they never imagined that teachers actually had other lives to lead or had anywhere to go but their classrooms.



“We’re not doing nothing,” squealed Ringo.

“I think you mean, ‘We are not doing *anything*,’ ” corrected Dr. Reeper in a teacherly voice, “which in any case isn’t true. You are obviously doing something, and if I find out that that something has to do with bullying smaller children—like, for example, George . . .” Dr. Reeper stared very hard at all the boys to see if any of them flinched at the mention of George’s name.

“No sir no sir no sir no sir,” said Ringo, who feared his ear might come off in the teacher’s hand. “We never touched him. We were running after him because he . . .”

“Left-his-lunchbox-behind-at-school,” said Whippet very quickly.

“And we wanted to give it back to him before he got home,” added Zit, the new boy.



“And did you succeed?” said Dr. Reeper with a nasty smile, letting go of Ringo’s ear just a little bit.

“We were just about to hand it over,” improvised Ringo, “when he went into that house.” He pointed at Eric’s front door. “So we were ringing the bell to give it to him.”

Dr. Reeper let go of Ringo’s ear so suddenly that Ringo fell to the ground.

“He went in there?” Dr. Reeper questioned them sharply as Ringo staggered to his feet again.

“Yeah.” They all nodded in unison.

“Why don’t you boys,” said Dr. Reeper slowly, “let me have George’s lunchbox and I’ll hand it back to him.” He fished around in his pocket and brought out a crumpled ten-dollar bill, which he dangled in front of their noses.

“Who’s got the lunchbox?” questioned Ringo.

“Not me,” said Whippet immediately.

“Not me,” mumbled Tank.

“It must be you then,” said Ringo, pointing at Zit.

“Ringo, I haven’t . . . I didn’t . . . I wasn’t . . .” Zit was panicking now.

“Very well,” said Dr. Reeper, glaring at the four of them. He put the money back in his pocket. “In that case, I think you’d better scam. Do you hear me? Scam!”

Once the boys—who didn’t need telling twice—were gone, Dr. Reeper stood in the street, smiling to himself. It wasn’t a pleasant sight. Checking that no one else was coming or going, he went up to Eric’s front window and squinted through it. The curtains were drawn, so he only had a small opening to look through. He couldn’t see much, just two strangely shaped, shadowy figures, which seemed to be standing near some kind of doorway inside the house.

“Interesting,” he muttered to himself. “Very, very interesting.”

Suddenly, the temperature in the street dropped dramatically. For a second it felt as though air from the North Pole were blowing along the street. Strangely, the bitter wind seemed to be coming from under Eric’s front door, but as Dr. Reeper bent down to investigate, it stopped. When he went back to look through the window, the two figures had gone and there was no inside doorway to be seen.

Dr. Reeper nodded to himself. “Ah, the chill of outer space—how I long to feel it,” he whispered, rubbing his hands together. “At last, Eric, I’ve found you! I knew you’d come back one day.”

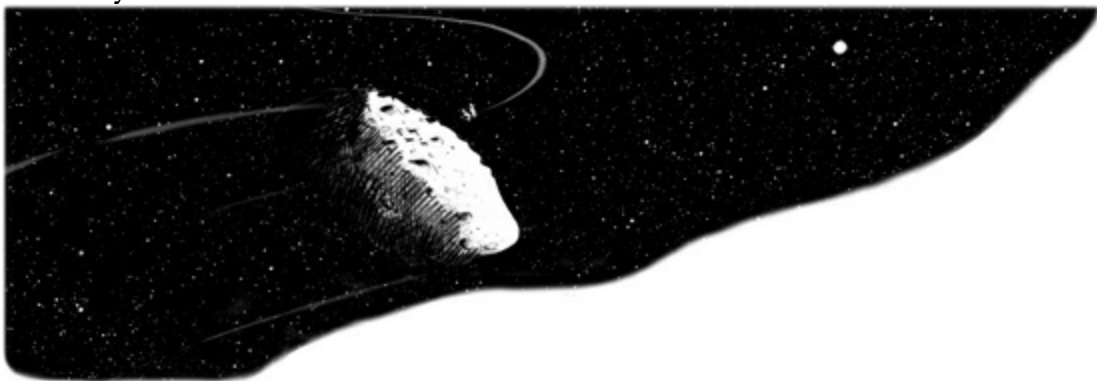


The title "Chapter Eleven" is centered in a bold, italicized font. It is surrounded by a stylized graphic of a star with eight points, overlaid with several overlapping elliptical orbits. Small circles, representing planets or moons, are placed at various points along these orbits.

Chapter Eleven

When he leaped over the threshold of the portal door, George found he was floating—not going up, not going down, just drifting in the huge, great darkness of outer space. He looked back toward the doorway, but the hole in space where it should have been had closed over as though it had never been. There was no way back now and the giant rock was getting closer all the time.

“Hold my hand!” Annie shouted to George. As he gripped her hand in its space glove even harder, he started to feel as if they were falling down toward the comet. Moving faster and faster, as if they were on a giant Tilt-a-Whirl, George and Annie spiraled toward the huge rock, getting closer and closer all the time. Beneath them, they could see that one side of the comet, the part facing the Sun, was brightly lit. But the other side, which the Sun’s rays didn’t reach, was in darkness. Eventually they landed in a heap on a thick layer of icy, dust-covered rubble. Luckily they’d come down on the bright side of the comet, so they could see what lay around them.



“Ha-ha-ha-ha!” Annie was laughing as she picked herself up. She hauled George to his feet and brushed bits of dirty ice and crumbly rock off him. “So?” she said. “Do you believe me now?”

“Where are we?” said George, who was so surprised he forgot to be scared. George felt extremely light. He looked around and saw rock, ice, snow, and darkness. It was like standing on a giant dirty snowball someone had thrown into outer space. Stars blazed everywhere, their fiery glow quite different from the twinkling lights he saw from the Earth.

“We’re having an adventure,” replied Annie. “On a comet. And it’s real—it isn’t a made-up story, is it?”

“No, it isn’t,” admitted George. He patted her space suit awkwardly. “I’m sorry I didn’t believe you, Annie.”

“That’s all right,” said Annie generously. “No one ever does. That’s why I had to show you. Look, George!” She waved an arm around. “You’re going to see the planets in the Solar System.” She started to pull a length of rope out of a pocket in her space suit. On the end of the rope was a spike, like a tent peg. Using her space boot, she jammed the spike into the ice on the comet’s surface.

Watching her, George gave a tiny little jump for joy. Even though he was wearing the space suit that had seemed very heavy on Earth, he couldn’t believe how light he felt. So light that he thought he could leap as high as he wanted. He did another little jump across a little crack on the comet’s surface. This time he went up and forward, but he didn’t come down again. He seemed to be taking a giant leap, maybe hundreds of feet long! He’d never be able to find Annie again . . .

“Help! Help!” George called through the helmet as his jump carried him farther and farther away, his arms whirling in the surrounding emptiness as he tried to make himself fall down onto the comet. But it was no good. Annie was far away in the distance now—he could only just see her when he looked back. The comet’s surface was passing quickly below him. He could see holes and little hills everywhere, but nothing that he could grab on to. But at last he seemed to fall. The ground was getting closer now, and as he landed he slid on the ice near the threshold between the bright and the dark side of the comet. In the distance, he saw Annie carefully running toward him.

“If you can hear me, *don’t jump again!*” she was saying in a very urgent voice. “If you can hear me, *don’t jump again!* If you can—”

“*I won’t!*” he called back as she reached him.

“Don’t *do* that, George!” said Annie. “You could have landed on the dark side of the comet. I might never have found you! Now stand up—the boots have small spikes on their soles.” She sounded very grownup and not at all like the impish little girl he had met at Eric’s house. “A comet is different from the Earth. We weigh much less here than we do there, so when we jump, it can take us a long, long way. This is a different world. Oh, look!” she added, changing the subject. “We’re just in time!”

“For what?” asked George.

“For *that!*” Annie pointed to the other side of the comet.

Behind the comet was a tail of ice and dust, which was getting steadily longer. As it grew, it caught the light from the faraway Sun and glistened in the wake of the comet, making it look as though thousands of diamonds were shining in outer space.

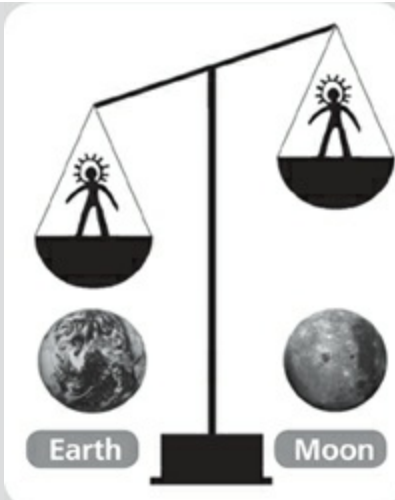
“That’s beautiful,” whispered George.

For a minute he and Annie just stood there in silence. As George watched the trail grow, he realized it was made up of bits of the bright side of the comet.

MASS



- The mass of a body measures the force needed to move it or to change the way it moves. Mass is often measured by weighing the body, but mass and weight are not the same. The weight of an object is the force attracting it to another object, such as the Earth or the Moon, and it depends on the mass of both objects and the distance between them. You weigh slightly less on top of a mountain because you are farther from the center of the Earth.



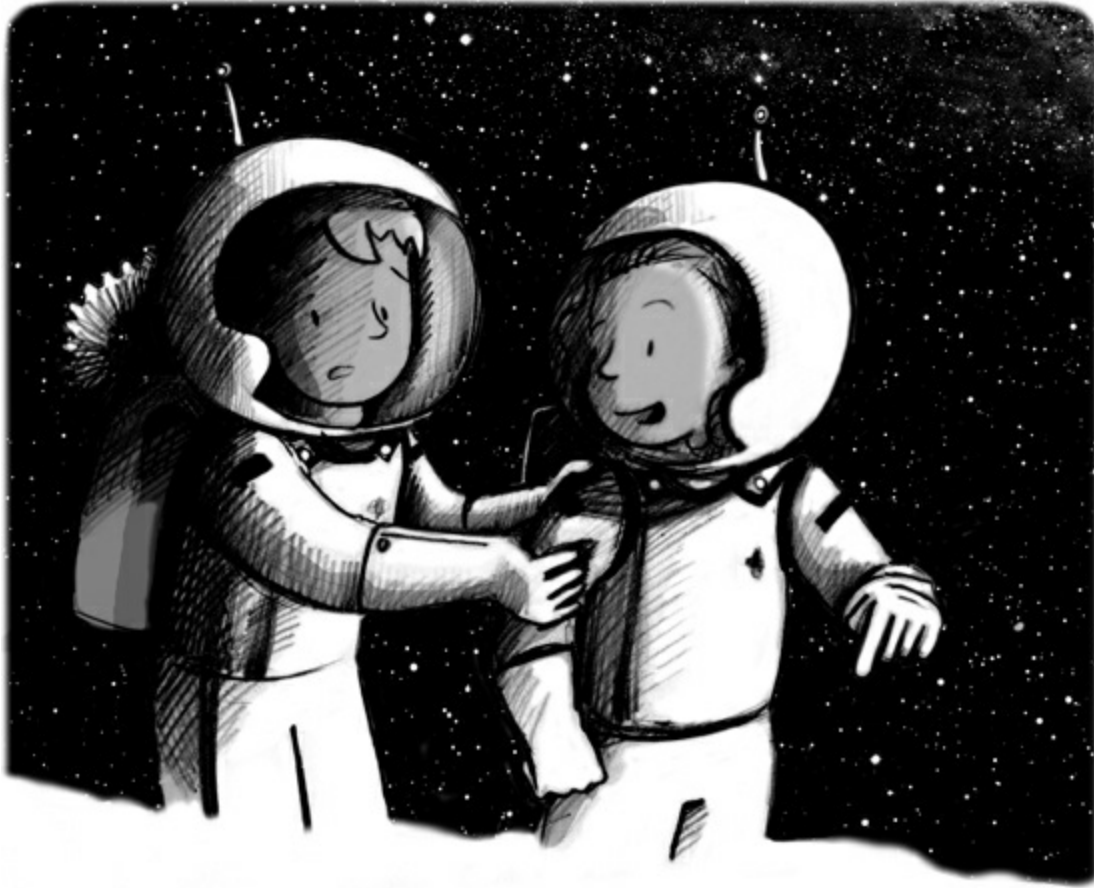
Because the mass of the Moon is much less than the mass of the Earth, an astronaut who weighs about 200 pounds (about 90 kg) on Earth would weigh only about 33 pounds (15 kg) on the Moon. So astronauts on the Moon could, with the correct training, beat any Earth-based long-jump record.

- 🌐 Einstein was a German physicist who was born in 1879. He discovered that energy is equivalent to mass, according to the famous equation $E=mc^2$, where "E" is energy, "m" is mass, and "c" is the speed of light. Because the speed of light is very large, Einstein and others realized that this equation suggested one could make an atom bomb, in which a small amount of mass is converted into a very large amount of energy in an explosion.
- 🌐 Einstein also discovered that mass and energy curve space, creating gravity.

"The rock's melting!" said George in a panic, clutching Annie's arm. "What will happen when there's nothing left?"

"Don't worry." Annie shook her head. "We're just getting closer to the Sun. The Sun slowly warms up the bright side of the comet and the ice turns into gas. But it's okay because there's enough ice here for us to pass the Sun loads of times. Anyway, the rock under the ice won't melt. So we won't start falling through space, if that's what you're scared of."

“I’m not scared!” protested George, letting go of her arm very suddenly. “I was just asking.”



“Then ask more interesting questions!” said Annie.

“Like what?” asked George.

“Like, what would happen if some of the rocks from the comet’s tail fell on the Earth?”

George kicked some dust around and then said reluctantly, “All right, what would happen?”

“Now that is a good question!” said Annie, sounding pleased. “The rocks catch fire when they enter the Earth’s atmosphere, and from the ground, when we look up, they become what we call shooting stars, or meteors.”

They stood and gazed until the comet’s tail got so long they couldn’t see the end of it. But as they were watching it, the comet seemed to start changing direction: All the stars in the background were moving. “What’s happening?” George asked.

“Quick!” Annie replied. “We’ve only got a few seconds. Sit down, George.” She cleared two little spaces on the ice, speedily brushing the powder aside with her glove. Reaching into another pocket of her suit, she produced what looked like climbing hooks. “Sit down!” she ordered again. She screwed the hooks into the ground and then fastened them onto a longish piece of cord hanging from a buckle on George’s suit. “Just in case something hits you,” she added.



“Like what?” asked George.

“Well, I don’t know. My dad normally does this part,” she replied. Next, she sat down behind George and did the same to herself. “Do you like roller coasters?” she asked him.

“I don’t know,” said George, who had never been on one.






“Well, you’re about to find out!” said Annie, laughing.

The comet was definitely falling—or at least changing direction toward what seemed to be “down.” From the way the stars were moving all around him, George understood that the comet was falling very fast. But he couldn’t feel anything—he didn’t have butterflies in his stomach, and there was no rush of air blowing past him. It wasn’t at all how he had expected a ride on a roller coaster to feel. But he was starting to realize that things feel very different in outer space from the way they do on Earth.

George closed his eyes for a moment, just to see if he could feel anything at all. But no, nothing. Suddenly, with his eyes closed, he realized that something in space must be pulling them and the comet toward it for the comet to change direction like that. George instinctively knew that this something was probably much, much bigger than the comet on which he and Annie were surfing through outer space.

COMETS



-  Comets are big, dirty, and not very round snowballs that travel around the Sun. They are made up of elements created in stars that exploded a long time before our Sun was born. It is believed that there are more than 100 billion of them, very far away from the Sun, waiting to come closer to us. But we can see them only when they come close enough to the Sun to have a shiny tail. We actually have seen only about 1,000 comets so far.
-  The largest known comets have a central core of more than 20 miles (32 km) from one side to the other.
-  When comets come close to the Sun, the ice in them turns into gas and releases the dust that was trapped inside. This dust is probably the oldest dust there is throughout the Solar System. It contains clues about our cosmic neighborhood at the very beginning of the life of all the planets, more than 6 billion years ago.

Most of the time, comets circle around the Sun from very far away (much, much farther away than the Earth). Every now and then, one of them starts to travel toward the Sun. There are then two possibilities:

1) Some, like Halley's Comet, will get trapped by the Sun's gravity. These comets will then keep orbiting the Sun until they melt completely or until they hit a planet. Halley's Comet's core is about 9.6 miles (16 km) long. It returns near enough to the Sun to melt down a bit and have a tail that can be seen by us about every 76 years. It was near us in 1986 and will be back in 2061. Some of the comets trapped by the Sun's gravity return near the Sun much more rarely. The Hyakutake Comet, for instance, will travel for 110,000 years before coming back.

2) Because they have too much speed or because they do not travel close enough to the Sun, some other comets, like Comet Swan, never come back. They pass by us once and then start an immense journey in outer space toward another star. These comets are cosmic wanderers. Their interstellar journey can take hundreds of thousands of years, sometimes less, sometimes even more.

The title "Chapter Twelve" is centered within a stylized graphic. The graphic features a large, light-colored star with eight points. Overlaid on the star are several concentric, slightly tilted elliptical orbits. Small circles of varying sizes are placed at various points along these orbits, representing celestial bodies or planets. The text "Chapter Twelve" is written in a bold, sans-serif font across the middle of the star and orbits.

Chapter Twelve

When George opened his eyes again, he saw a massive pale yellow planet with a belt of rings rising in the dark sky ahead of them. They sped along on the comet, heading for a point just above the rings. From far away, the rings looked like soft ribbons. Some were pale yellow, like the planet itself; others were darker.

“This is Saturn,” said Annie. “And I saw it first.”

“I know what it is!” replied George. “And what do you mean, ‘first’? I’m in front of you. *I* saw it first!”

“No, you weren’t looking, you were too scared! You had your eyes shut!” Annie’s voice rang inside his helmet. “*Ner-ner-na-ner-ner.*”



“No I didn’t!” protested George.

“Shhh!” Annie interrupted him. “Did you know that Saturn is the second biggest of the planets that move around the Sun?”

“Of course I knew,” lied George.

“Oh really?” replied Annie. “Then if you knew that, you’ll know which is the biggest planet of all.”

“Well . . . um . . . ,” said George, who had no idea. “It’s the Earth, isn’t it?”

“*Wrong!*” trumpeted Annie. “The Earth is teeny-weeny, just like your silly little brain. The Earth is only number five.”

“How do you know that?”

“How do I know you’ve got a silly little brain?” said Annie sarcastically.

“No, stupid,” said George furiously. “How do you know about the planets?”

“Because I’ve done this trip many, many times before,” said Annie, tossing her head as though throwing back her ponytail. “So let me tell you. And listen carefully,” she ordered. “There are eight planets orbiting the Sun. Four are huge and four are small. The huge ones are Jupiter, Saturn, Neptune, and Uranus. But the two biggest are so much bigger than the others that they are called the Giants. Saturn is the second of the giant planets, and the biggest one of all is Jupiter. The four small planets are Mars, Earth, Venus, and Mercury,” she continued, ticking them off on her fingers. “The Earth is the biggest of the small ones, but if you put these four together into a ball, you still wouldn’t get anything nearly as big as Saturn. Saturn is more than forty-five times bigger than these four small planets added together.”

Annie was clearly delighted to be showing off about the planets. Even though he was very annoyed by how smug she was, George was secretly impressed. All he had ever done was dig potatoes and mess around with a pig in his backyard. It wasn’t much in comparison with riding around the Solar System on a comet.

As Annie talked, the comet flew nearer and nearer to Saturn. They got so close that George could see that the rings were made not of ribbons but of ice, rocks, and stones. These were all different sizes, the smallest no bigger than a speck of dust, the largest about twelve feet long. Most of them were moving much too fast for George to catch one. But then he spotted a small chunk of rock calmly floating right next to him. A quick glance behind showed that Annie wasn’t looking. He reached out, snatched up the rock, and held it in his space glove! A real treasure from

outer space! His heart was beating fast. The sound was so loud in his ears that he thought Annie must be able to hear it through the sound transmitter in his helmet. He suspected that taking things home from outer space was probably not allowed, so he hoped she hadn't noticed.

"George, are you all right?" asked Annie. "Why are you wriggling around like that?"

George quickly thought of something to say to divert her attention from the rock he was trying to stuff into his pocket.



THE SOLAR SYSTEM



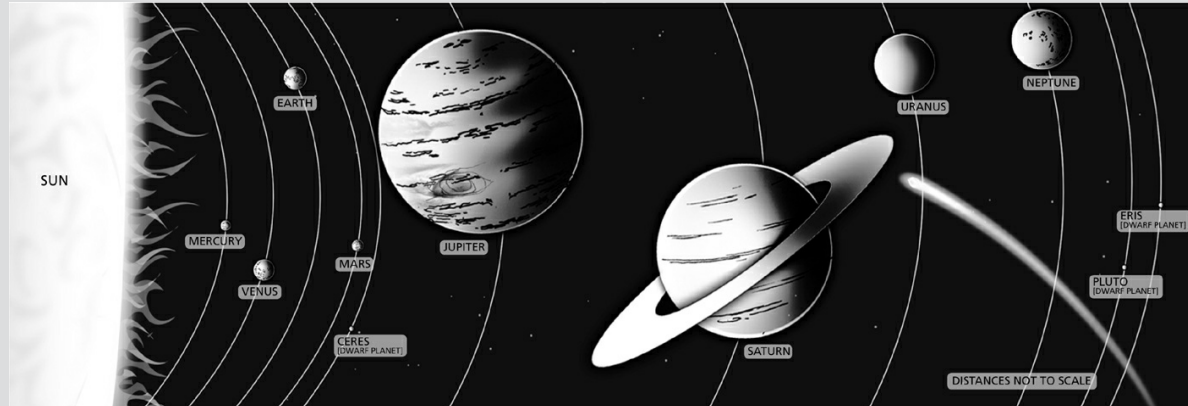
- **The Solar System is the cosmic family of our Sun. It comprises all the objects trapped by the Sun's gravity: planets, dwarf planets, moons, comets, asteroids, and other small objects yet to be discovered. An object trapped by the Sun's gravity is said to be in orbit around the Sun.**
- Closest planet to the Sun: Mercury Mercury is 36 million miles (57.9 million km) away from the Sun on average
- Farthest planet from the Sun: Neptune Neptune is 2.8 billion miles (4.5 billion km) away from the Sun on average

🌍 Distance of the Earth from the Sun: 93 million miles

(149.6 million km) on average



- Number of planets: 8
- From closest to the Sun, the planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune



- Number of dwarf planets: 3
- From closest to farthest to the Sun, the dwarf planets are: Ceres, Pluto, and Eris
- Number of known planetary moons: 165 Mercury: 0; Venus: 0; Earth: 1; Mars: 2; Jupiter: 63; Saturn: 59; Uranus: 27; Neptune: 13
- Number of known comets: 1,000 (estimated real number: 1,000,000,000,000,000)

Farthest distance traveled by a man-made object: more than 9.3 billion miles (14.96 billion km). Nine billion three hundred million miles is the distance reached by *Voyager 1* on August 15, 2006, at 10:13 a.m. (Greenwich Mean Time). This corresponds to exactly 100 times the distance from the Earth to the Sun. *Voyager 1* is still traveling away.

“Why did we change direction? Why did our comet move toward Saturn? Why didn’t we continue in a straight line?” he babbled.

“Oh dear, you just don’t know anything at all, do you?” sighed Annie. “It’s lucky for you that I’m such a fount of useful scientific knowledge,” she added importantly. “We moved toward Saturn because we fell toward it. Just like an apple falls on Earth, just like we fell onto the comet when we arrived, just like the particles in space clouds fall onto each other and become balls that become stars. Everything falls toward everything throughout the Universe. And do you know the name of what causes this fall?”

George didn’t have a clue.

“It’s called gravity.”

“So it’s because of gravity that we’re going to fall on Saturn now? And crash?”

“No, silly! We’re moving way too fast to crash. We’re just flying by to say hello.”

Annie waved to Saturn and shouted, “*Hello, Saturn!*” so loudly that George’s hands automatically tried to cover his ears, but he couldn’t because of his helmet, so instead he yelled back, “*Don’t shout!*”

“Oh, I’m sorry,” she said. “I didn’t mean to.”


As they whizzed past Saturn, George saw that Annie was right—the comet didn’t fall all the way onto the giant planet but cruised straight past it. With some distance now, he could see that Saturn not only had rings, but also a moon, like the Earth. Looking closer, he could hardly believe his eyes! He saw another moon, and another and yet another! In total, he saw five large moons and even more small ones before Saturn was too far away for him to keep counting. *Saturn has at least five moons!* he thought. George hadn’t known that a planet other than the Earth could have even one moon, let alone five! He looked at Saturn with respect as the giant planet with rings shrank into the distance behind them until it was just a bright dot in the starry background.



SATURN





- ☉ Saturn is the sixth closest planet to the Sun.
- ☉ Average distance to the Sun: 888 million miles (1,430 million km)
- ☉ Diameter at equator: 74,898 miles (120,536 km) corresponding to 9.449 diameters at equator on Earth
- ☉ Surface area: 83.7 × Earth's surface area
- ☉ Volume: 763.59 × Earth's volume
- ☉ Mass: 95 × Earth's mass

 Gravity at the equator: 91.4% of Earth's gravity at Earth's equator



It takes Saturn 29.46 Earth-years to circle around the Sun. 

-  Structure: Hot, rocky core that is surrounded by a liquid metal layer that is itself surrounded by a liquid hydrogen and helium layer. There then is an atmosphere that surrounds it all.
-  Winds have been recorded at speeds up to 1,116 mph (1,795 km/h) in Saturn's atmosphere. By comparison, the strongest wind ever recorded on Earth is 231 mph (371.68 km/h) at Mount Washington, New Hampshire, USA, on April 12, 1934. It is believed that wind speeds can sometimes reach over 300 mph (480 km/h) inside tornadoes. However devastating these are, these winds are still very slow compared to Saturn's winds.

So far, Saturn has 59 confirmed moons. Seven of them are round. Titan, the largest, is the only known moon within the Solar System to have an atmosphere. In volume, Titan is more than three times bigger than our Moon.



The comet was now traveling straight again. In front of them, the Sun was bigger and brighter than before, but still very small compared to its size when seen from the Earth. George spotted another bright dot that he hadn't noticed before, a dot that was quickly growing bigger as they approached it.

"What's over there?" he asked, pointing ahead and to the right. "Is that another planet?"

But there was no reply. When he looked around, Annie had gone. George untied himself from the comet and followed the trail of footprints she had left in the icy powder. He carefully gauged the length of his steps so that he wouldn't find himself flying off the comet again.

After climbing carefully over a small icy hill, he saw her. She was peering into a hole in the ground. Around the hole were bits and pieces of rock that seemed to have been spat out by the comet itself. George walked over and looked down into the hole too. It was a few feet deep, with nothing much to be seen at the bottom.



“What is it?” he asked. “Have you found something?”

“Well, you see, I went for a walk—,” Annie started to explain.

“Why didn’t you tell me?” George interrupted her.

“You were shouting at me about not shouting!” said Annie. “So I thought I’d just go by myself. Because then there’d be no one to get *mad* at me,” she added pointedly.

“I’m not *mad* at you,” said George.

“Yes, you are! You’re always angry with me. It doesn’t make any difference if I’m nice to you or not.”

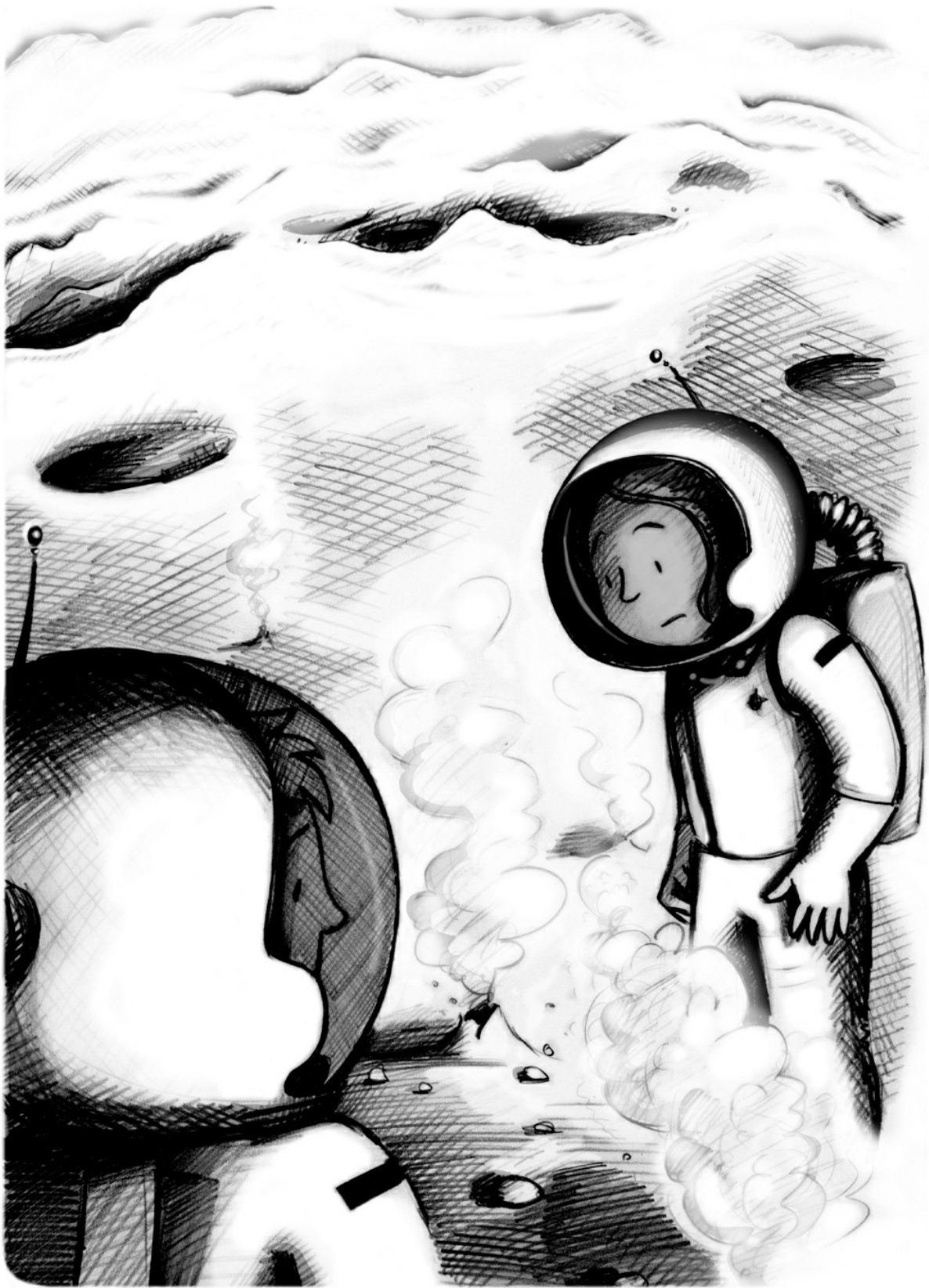
“*I’m not angry!*” shouted George.

“*Yes, you are!*” shouted back Annie, balling her gloved hands into fists and shaking them at George. As she did so, something extraordinary happened. A little fountain of gas and dirt blew up from the ground just next to her.

“Now look what you’ve done!” complained George. But as he spoke, another little fountain erupted through the rock right next to him. It formed a cloud of dust that slowly dispersed.

“Annie, what’s happening?” he asked.

“Um, it’s nothing,” replied Annie. “This is all fine, don’t worry.” But she didn’t sound very sure. “Why don’t we go and sit down where we were before?” she suggested. “It’s nicer over there.”



But as they walked back, more and more little geysers of dust erupted around them, leaving a haze of smoke in the air. Neither of them felt very safe, but neither of them wanted to admit it. They just walked more and more quickly toward the place where they'd been sitting before. Without saying a word, they anchored themselves to the comet once more.

In the sky, the bright dot George had seen growing had become much bigger. It now looked like a planet with red and blue stripes.

"That's Jupiter," Annie said, breaking the silence. But she was whispering now. She didn't sound like the confident show-off she had been earlier. "It's the biggest of the planets, about twice the volume of Saturn. That makes it more than a thousand times the volume of Earth."

"Does Jupiter have moons too?" George asked.

"Yes, it does," replied Annie. "But I don't know how many. I didn't count them last time I was here, so I'm not sure."

"Have you really been here before?" George looked suspicious.

"Of course I have!" said Annie indignantly. George wasn't sure he believed her.

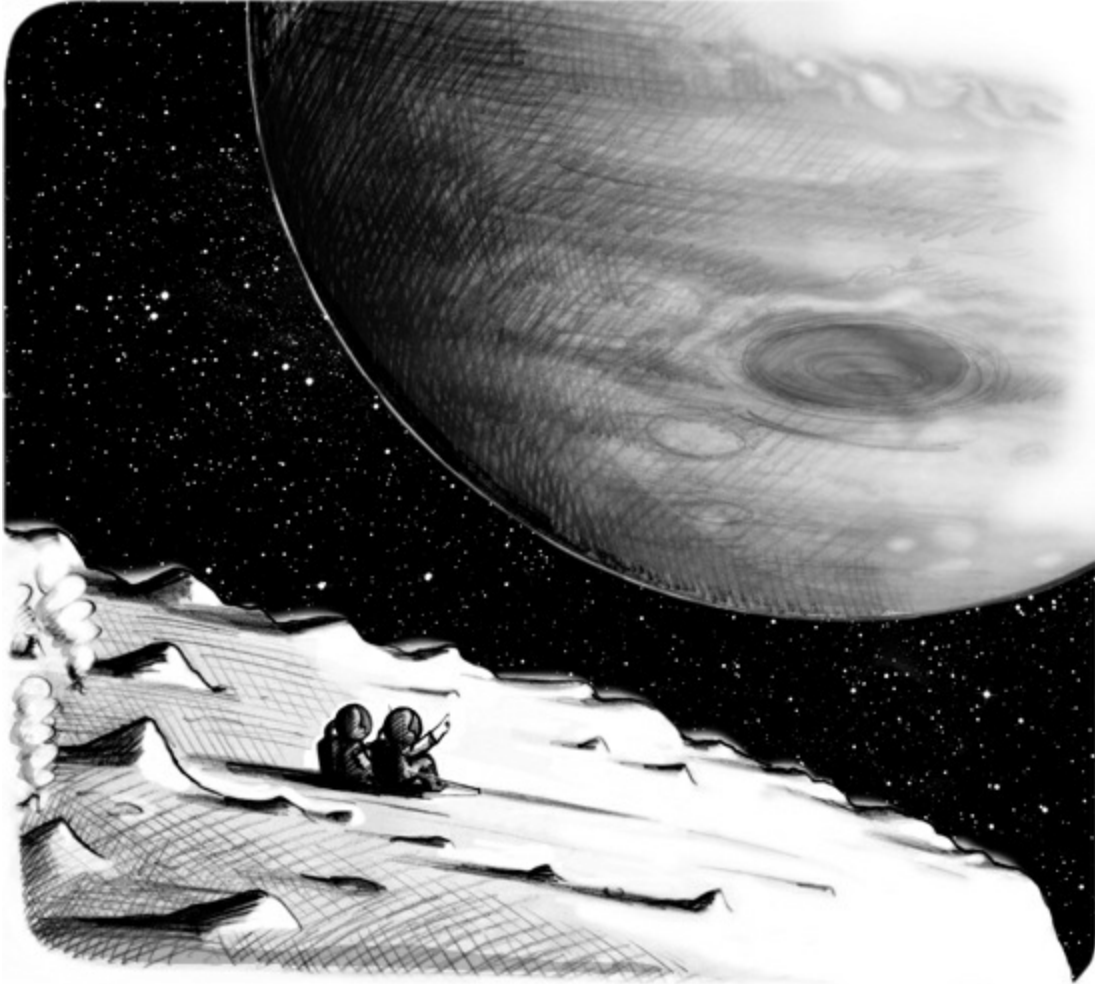
Once again, the comet and Annie and George started to fall. As they fell, George gazed at Jupiter. Even by Saturn's standards, Jupiter was enormous.

As they flew by, Annie pointed out a big red mark on Jupiter's surface.

"That thing," she said, "is a huge storm. It's been going on for hundreds and hundreds of years. Maybe even more, I don't know. It's over twice the size of the Earth!"

As they moved away from Jupiter, George counted how many moons he could spot.

"Four big ones," he said.



“ ‘Four big ones’ what?”

“Moons. Jupiter has four big moons and lots and lots of little moons. I think it has even more moons than Saturn.”

“Oh, okay,” said Annie, who was sounding nervous now. “If you say so.”

George was worried—it wasn’t like Annie to agree with anything he said. He noticed she had shuffled a little closer to him. She slipped her hand in its space glove into his. All around them, new jets of gas and dust were springing up out of the rock, each one spitting out a small cloud. A thin haze was forming over the whole comet. “Are you all right?” he asked Annie. She had stopped showing off and being rude, and he felt sure something was very wrong.

“George, I—,” Annie started to reply, when a huge rock smashed into the comet behind them, shaking the ground like an earthquake and sending up even more dust and ice into the haze.

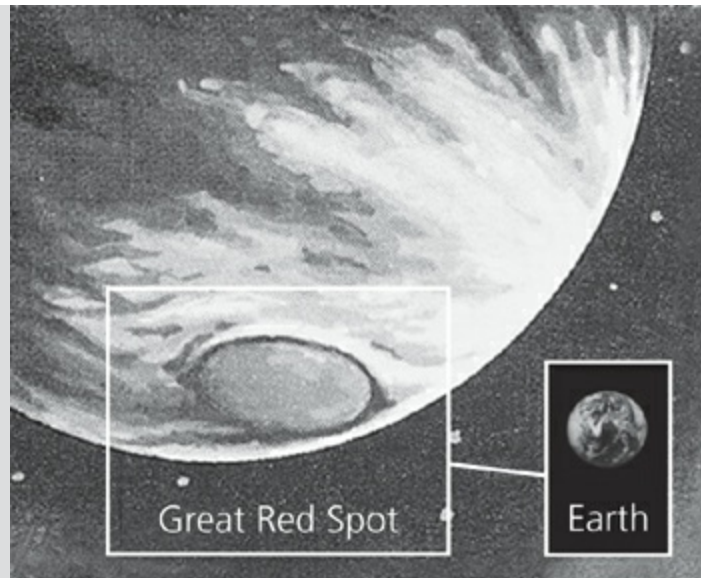
Looking up, George and Annie saw there were hundreds and hundreds of rocks, all coming toward them at high speed. And there was nowhere to hide.

“Asteroids!” cried Annie. “We’re in an asteroid storm!”

JUPITER



- Jupiter is the fifth closest planet to the Sun.
- Average distance to the Sun: 483.6 million miles (778.3 million km)
- Diameter at equator: 88,846 miles (142,984 km), corresponding to 11.209 diameters at equator on Earth
- Surface area: $120.5 \times$ Earth’s surface area
- Volume: $1,321.3 \times$ Earth’s volume
- Mass: $317.8 \times$ Earth’s mass
- Gravity at the equator: 236% of Earth’s gravity at Earth’s equator
- Structure: Small (compared to the overall size of the planet) rocky core surrounded by a liquid metal layer that smoothly turns into a liquid hydrogen layer as height increases. This liquid then smoothly turns into an atmosphere made of hydrogen gas, which surrounds it all. Even though it is bigger, Jupiter’s overall composition is similar to Saturn’s.
- The Great Red Spot on Jupiter’s surface is a giant hurricane-type storm, a storm that has lasted for more than three centuries (it was first observed in 1655), but it may have been there for even longer. The Great Red Spot storm is huge: more than twice the size of the Earth. Winds on Jupiter often reach 620 mph (1,000 km/h).



- It takes Jupiter 11.86 Earth-years to circle around the Sun.
- So far, Jupiter has 63 confirmed moons. Four of them are big enough to be round and were seen by the Italian scientist Galileo in 1610. These are collectively known as the Galilean moons. They are Io, Europa, Ganymede, and Callisto, and they are about the same size as our Moon.



Chapter Fourteen

“What do we do?” yelled George.

“Nothing,” shrieked Annie. “There’s nothing we *can* do! Try not to get squashed! I’ll call Cosmos to get us back.”

The comet shot through the asteroids with incredible speed. Another large rock hit the comet just in front of them, raining down smaller rocks on their space suits and helmets. Through the voice transmitter in his helmet, George heard Annie scream. But suddenly the scream went silent—the noise just stopped like a radio being switched off.

George tried to say something to Annie through the voice transmitter, but she didn’t seem to hear him. He turned to look at her. He could see she was trying to speak to him from inside the glass space helmet, but he couldn’t hear anything she said. He shouted as loudly as he could: “*Annie! Get us home! Get us home!*” But it was no use. He could see now that the tiny antenna on her helmet was snapped in half. That must be why he couldn’t talk to her! Did this mean she couldn’t talk to Cosmos either?

Annie was nodding like crazy and holding on to George very tightly. She was trying as hard as she could to summon Cosmos to come and get them both, but the computer wasn’t answering. As George feared, the device that linked her both to him and to Cosmos had been broken by the rocks raining down on them. They were stuck on the comet, flying through an asteroid storm, and it seemed there was no way out. George tried to call Cosmos himself, but he didn’t know how to do it or whether he even had the right equipment. He got no reply. Annie and George hung on to each other and squeezed their eyes shut.



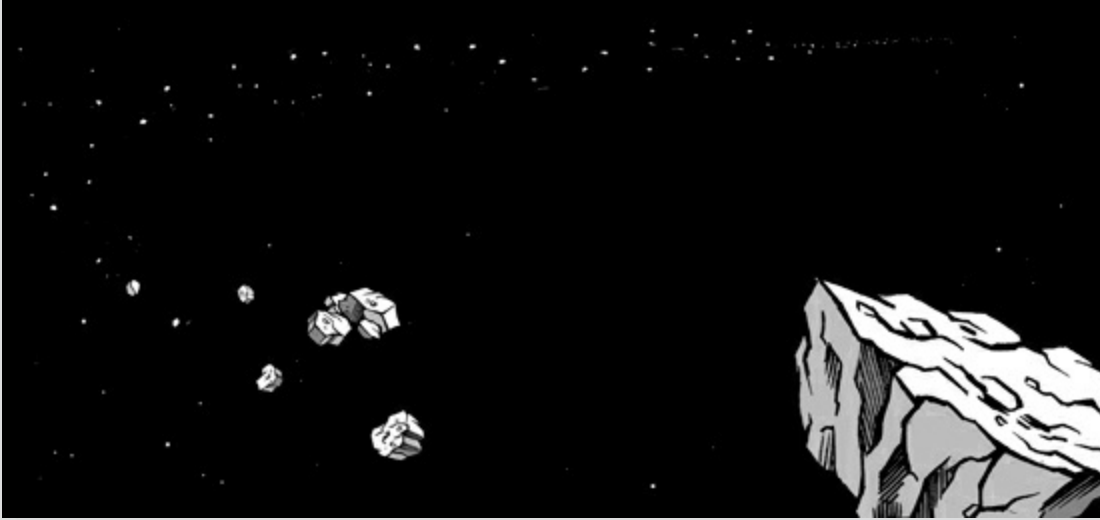
But just as suddenly as the storm had started, it stopped again. One minute rocks were thudding down on the comet all around them, the next the comet had flown out of the other side of the storm. Looking around, George and Annie realized how very lucky they had been to escape. The rocks were forming a huge line that seemed to extend all the way through space. They were mainly large and scattered thinly along the line, except where the comet had flown through. The rocks here were much smaller but more densely packed.

However, they were still far, far from safe. Jets of gas from the comet were now shooting out everywhere. Soon one could erupt right underneath them. It was now so hazy from all the explosions that they could hardly see the sky. Just the Sun and a faint little blue dot that was slowly getting bigger.

George turned back to Annie and pointed at the blue dot ahead. She nodded and tried to spell out a word with the finger of her space glove in the air. George could only make out the first letter—*E*. As they got closer to it, the comet tilted slightly toward it, and George suddenly realized what Annie was trying to tell him. It was *E* for Earth! The tiny blue dot in front of him was the planet Earth. It was so small compared to the other planets, and so beautiful. And it was his planet and his home. He desperately wanted to be back there now, this very second. He wrote “Cosmos” in the air with his space glove. But Annie just shook her head and wrote the word “NO” with her finger.

ASTEROID BELT





- ☾ Asteroids are objects that orbit the Sun but are not big enough to be round and to be called planets or dwarf planets. There are millions of them around the Sun: 5,000 new asteroids are discovered every month. Their size varies from a few inches across to several hundred miles wide.
- ☾ There is a ring full of asteroids that circle the Sun. This ring lies between Mars and Jupiter. It is called the Asteroid Belt. Even though there are a lot of asteroids in the Asteroid Belt, it is so huge and spread out that most of the asteroids there are lone space travelers. Some places, however, may be more crowded than others.

Around them on the comet, conditions were getting worse by the second. Hundreds and hundreds of fountains of gas and dust were erupting all over it. They huddled together, two castaways in space, with no idea how to get out of the awful trouble they had landed themselves in.

At least, George thought, in a strange, dreamlike way, I've seen the Earth from space. And he wished he could have told everyone back home how tiny and fragile the Earth was compared to the other planets. But there was no way they could get back home now. The fog of dust and gas was now so thick that they had even lost sight of the Earth's blue color. How could Cosmos have let them down like this?

George was just wondering if this was the last thought he'd ever have when suddenly a doorway filled with light appeared on the ground next to them. Through it came a man in a space suit, who unhooked them both from the comet and, one at a time, picked them up and threw them through the door. A split second later, Annie and then George landed with a bump on the floor of Eric's library. The man who had grabbed them quickly followed and the doorway slammed shut behind him. Pulling off his space helmet and glaring down at George and Annie, who were sprawled on the library floor in their space suits, Eric shouted, "*What on Earth did you think you were doing?!*"



A graphic for Chapter Fifteen featuring a central eight-pointed star. The star is surrounded by several overlapping elliptical orbits, some with small circles representing planets or moons. The text "Chapter Fifteen" is written in a bold, italicized font across the center of the star.

Chapter Fifteen

“What on Earth did you think you were doing?!”

Eric was so angry that, for a moment, George wished he were still on the roller-coaster comet, heading straight for the heart of the Sun.

“Actually, we weren’t on the Earth,” murmured Annie, who was struggling out of her suit.

“I heard that!” George hadn’t thought Eric could get any angrier than he already was, but now he looked so furious, George thought he might explode. He half expected to see great jets of steam burst out of his ears, just like the ones on the comet.

“Go to your room, Annie,” ordered Eric. “I’ll talk to you later.”

“But Da-ddy . . . ,” Annie began. But even she fell silent under Eric’s glare. She pulled off her heavy space boots, wriggled out of her suit, and shot out of the door like a streak of blond lightning. “Bye, George,” she muttered as she ran past him.

“As for you . . . ,” said Eric in such a menacing tone that George’s blood ran cold. But then he realized Eric wasn’t talking to him. He was looming over Cosmos, casting threatening looks at the computer screen.

“Master,” said Cosmos mechanically, “I am just a humble machine. I can only obey the commands I am given.”

“Ridiculous!” cried Eric wildly. “You are the world’s most powerful computer! You let two children travel into outer space by themselves. If I hadn’t come home when I did, who knows what might have happened? You could have—you *should* have—stopped them!”



“Oh dear, I think I am about to crash,” replied Cosmos, and his screen suddenly went blank.

Eric clutched his head in his hands and staggered around the room for a minute. “I can’t believe this,” he said, as though to himself. “Terrible, terrible!” He groaned loudly. “What a disaster!”



“I’m very sorry,” said George timidly.

Eric whipped around and stared at him. “I trusted you, George,” he said. “I would never have showed you Cosmos if I’d thought that the minute my back was turned, you would sneak through the doorway into outer space like that. And taking a younger child with you! You have no idea how dangerous it is out there.”

George wanted to shout that this was so unfair! It wasn’t his fault—it was Annie who had pushed them both through the doorway into outer space, not him. But he kept quiet. Annie, he figured, was in enough trouble already without him making it worse.

“There are things in outer space you can’t even imagine,” continued Eric. “Extraordinary, fascinating, enormous, amazing things. But dangerous. So dangerous. I was going to tell you all about them, but now . . .” He shook his head. “I’m going to take you home.” And then Eric said a terrible thing. “I need to have a word with your parents.”

As George found out afterward, Eric had more than just one word with his parents. In fact, he had quite a few, enough to make them feel very disappointed in their son. They were very hurt that despite all their good intentions about bringing up George to love nature and hate technology, he’d been caught red-handed at Eric’s house playing with a computer. A valuable and delicate one no less; one that wasn’t for kids to touch. Worse, George had invented some kind of game (Eric had become

somewhat vague at this point), which he'd persuaded Annie to join in, and this game had been very dangerous and very silly. As a result, the two children were both grounded and not allowed to play together for a whole month.

“Good!” said George when his dad told him what his punishment would be. At that moment he never wanted to see Annie again. She'd got him into so much trouble already, and yet George had been the one to take all the blame.



“And,” added George’s dad, who was looking very angry and bristly today with his big, bushy beard and his itchy, hairy homemade shirt, “Eric has promised me he will keep his computer locked up so neither of you will be able to get near it.”

“*No-o-o!*” yelled George. “He can’t do that!”

“Oh yes he can,” said George’s dad very severely. “And he will.”

“But Cosmos will get lonely all by himself!” said George, too upset to realize what he was saying.

“George,” said his dad, looking worried, “you do understand that this is a computer and not a living being we’re talking about? Computers can’t get lonely—they don’t have feelings.”

“But this one does!” shouted George.

“Oh dear,” sighed his dad. “If this is the effect that technology has on you, you see how right we are to keep you away from it.”

George ground his teeth in frustration at the way adults twisted everything to make it sound like they were always right, and then dragged his feet up the stairs to his room. The world suddenly seemed a much more boring place.

• • •

George knew he was going to miss Cosmos, but what he didn't expect was that he would miss Annie too. At first he was pleased to be banned from seeing her—it was good to have a punishment that stopped him from doing something he didn't want to do anyway. But after a while he found himself looking for the flash of her golden hair. He told himself he was just bored. He was grounded, so he couldn't go and see any of his other friends, and there wasn't much for him to do at home that was any fun—his mom wanted him to weave a rug for his bedroom, and his dad attempted to get him interested in his homemade electricity generator. George tried to be enthusiastic, but he felt rather flat.



The only bright star in his life was that he'd seen a poster at school advertising a science-presentation competition. The first prize was a

computer! George desperately wanted to win. He spent ages trying to write a really good talk about the wonders of the Universe and drawing pictures of the planets he'd seen on the comet ride. But no matter how hard he tried, he just couldn't seem to get the words right. Everything sounded wrong. Eventually he gave up in frustration and resigned himself to a boring life forever and ever.



But then at last something interesting happened. One gray autumn afternoon at the end of October—the slowest and dullest month he had ever lived through—George was loafing around in the backyard when he noticed something unusual. Through a small round hole in the fence he saw something very blue. He went over to it and pressed his eye socket to the fence. From the other side he heard a squeak.

“George!” said a familiar voice. He was eye to eye with Annie.

“We’re not supposed to be talking to each other,” he whispered through the fence.

“I know!” she said. “But I’m so bored.”

“You’re bored! But you’ve got Cosmos!”

“No, I haven’t,” said Annie. “My dad has locked him up so I can’t play with him anymore.” She sniffed. “I’m not even allowed to go trick-or-treating for Halloween this evening.”



“Me neither,” said George.

“I’ve got such a pretty witch’s costume too,” said Annie sadly.

“My mom’s making pumpkin pie right now,” George told her glumly. “I bet it’ll be horrible. And when she’s finished, I’ll have to go and eat a slice of it in the kitchen.”

“Pumpkin pie!” said Annie longingly. “That sounds really good. Can I have your slice if you don’t want it?”

“Yeah, but you’re not allowed in my kitchen, are you? After what happened . . . last time we played together.”

“I’m really sorry,” said Annie. “About the comet ride and the asteroids and the jets of gas and my dad getting angry with you. And everything. I didn’t mean it.”

George didn’t reply. He’d thought of so many angry things to say to Annie, but now that he was nearly face-to-face with her, he didn’t feel like saying any of them.

“Oh dear.” Annie sniffed.

From the other side of the fence, George thought he heard the noise of crying. “Annie?” he called quietly. “Annie?”

Brrreeewwwhh! George heard a sound like someone furiously blowing their nose.

He ran down the length of the fence. His dad had started to mend the hole where Freddy had broken through into Next Door, but he'd got distracted halfway through and had forgotten to finish the job. There was still a little gap, maybe large enough for a small person to squeeze through.

"Annie!" George poked his head through the space. He could see her on the other side now, wiping her nose on her sleeve and rubbing her eyes. Wearing normal clothes, she no longer looked like a strange fairy child or a visitor from outer space. She just looked like a lonely little girl. Suddenly George felt really sorry for her. "Come on!" he said. "Climb through! We can hide together in Freddy's sty."

"But I thought you hated me!" said Annie, scampering down to the hole in the fence. "Because of—"

"Oh, that!" said George carelessly, as though he'd never given it a moment's thought. "When I was a little kid, I *would* have minded," he said grandly. "But I don't now."

"Oh," said Annie, whose face was blurred by tears. "So, can we be friends?"

"Only if you climb through the fence," teased George.

"But what about your dad?" asked Annie doubtfully. "Won't he be angry again?"



“He’s gone out,” said George. “He won’t be back for hours.” In fact, that morning George had been pretty glad to be grounded. Sometimes on Saturdays his dad took George with him when he went on global-warming protest marches. When he was younger, George had loved the marches—he’d thought that walking through the center of town carrying a sign and shouting slogans was great. The eco-warriors were fun and sometimes they would give George piggyback rides or mugs of steaming homemade soup. But now that George was older, he found going on marches a bit embarrassing. So when his dad had sternly told him that morning that, as part of his ongoing punishment, he would have to miss that day’s protest march and stay at home, George pretended to be sad so as not to hurt his dad’s feelings. But secretly he had breathed a sigh of relief.



“Come on, Annie, jump through,” he said.

The pigsty wasn't the warmest or the most comfortable place to sit, but it was the one best hidden from angry grown-up eyes. George thought Annie might protest at the smell of pig—which wasn't as strong as people tended to think—but she just wrinkled her nose and then snuggled down in some straw in the corner. Freddy was asleep, his warm breath coming out in little piggy snores as he dozed, his big head resting on his hooves.

“So, no more adventures?” George asked Annie, settling down next to her.



“Not likely,” said Annie, scuffing her sneakers against the pigsty wall. “Dad says I can’t go into outer space again until I’m really old, like twenty-three or something.”

“Twenty-three? But that’s ancient!”

“I know,” sighed Annie. “It’s forever away. But at least he didn’t tell my mom. She would have been *really* angry. I promised her I’d look after Dad and stop him from doing anything silly.”

“Where is your mom anyway?” asked George.

“My mom,” said Annie, tilting her head in a way he had come to recognize, “is dancing *Swan Lake* with the Bolshoi Ballet in Moscow.”

In his sleep, Freddy gave a loud snort.

“No, she isn’t,” said George. “Even Freddy knows that’s not true.”

“Oh, all right,” agreed Annie. “She’s taking care of Granny, who isn’t very well.”

“Then why didn’t you say so?”

“Because it’s much more interesting to say something else. But it was true about outer space, wasn’t it?”

“Yes, it was,” said George. “And it was amazing. But . . .” He paused.

“What?” said Annie, who was braiding Freddy’s straw.

“Why does your dad go there? I mean, why does he have Cosmos? What’s he for?”

“Because he’s trying to find a new planet in the Universe.”

“What sort of new planet?” asked George.

“A special one. One where people could live. Y’know, in case the Earth gets too hot.”

“Wow! Has he found one?”

“Not yet,” said Annie. “But he keeps looking and looking, everywhere across all the galaxies in the Universe. He can’t stop until he finds one.”

“That’s amazing. I wish I had a computer that could take me across the whole Universe. Actually, I wish I had a computer at all.”



“You don’t have a computer?” Annie sounded surprised. “Why not?”

“I’m saving up for one. But it’s going to take years and years and years.”

“That’s not much good, is it?”

“So,” said George, “I’m entering a science competition, and the first prize is a computer, a really huge one!”

“What competition?”

“It’s a science presentation. You have to give a talk. And the person who gives the best one wins the computer. Lots of schools are taking part.”

“Oh, I know!” said Annie, sounding excited. “I’m going to it with my

school—it's next week, isn't it? I'm staying at Granny's all next week, but I'll see you at the competition."

"Are you entering?" George asked, suddenly worried that Annie, with her interesting life, scientific know-how, and vivid imagination, would pull off a presentation that made his own sound about as exciting as cold rice pudding.

"No, of course not!" said Annie. "I don't want to win a stupid computer. If it was some ballet shoes, then that would be different . . . What are you going to talk about?"

"Well," said George shyly, "I've been trying to write something about the Solar System. But I don't think it's very good. I don't know very much about it."

"Yes, you do!" said Annie. "You know lots more than anyone else at school does. You've actually seen parts of the Solar System, like Saturn, Jupiter, asteroids, and even the Earth from outer space!"

"But what if I've got it all wrong?"

"Why don't you get Dad to check it for you?" suggested Annie.

"He's so mad at me," said George sadly. "He won't want to help me."

"I'll ask him this evening," said Annie firmly. "And then you can come by after school on Monday and talk to him."

At that moment there was a gentle tap on the roof. The two children both froze as the door to the pigsty swung open.

"Hello?" said a nice voice.

"It's my mom!" George mouthed silently to Annie.

"Oh no!" she mouthed back.

"Trick or treat?" said George's mom.

"Treat?" said George hopefully. Annie nodded.

"Treat for two?"

"Yes, please," replied George. "For me and, um, Freddy, that is."

"Freddy's a funny name for a girl," said George's mom.

"Oh, please, George's mom!" Annie burst out. She couldn't stay silent any longer. "Don't let George get into more trouble! It isn't his fault!"

"Don't worry," said George's mom in the kind of voice that they both knew meant she was smiling. "I think it's silly that you can't play together. I've brought you both a snack—some nice broccoli muffins and a slice of pumpkin pie!"

With a squeak of delight, Annie fell on the plateful of lumpy, funny-shaped muffins. “Thank you!” she mumbled through a mouthful of muffin. “These are delicious!”



Chapter Sixteen

Meanwhile, on the other side of town, George's dad was enjoying his environmental protest march. Holding up huge signs and shouting slogans, the campaigners charged across the shopping district, batting the crowds aside. *"The planet is dying!"* they yelled as they marched to the town square. *"Recycle plastic bags! Ban the car!"* they bellowed to surprised passers-by. *"Stop wasting the Earth's resources!"* they yelled.

When they reached the middle of the square, George's dad jumped up onto the base of a statue to give a speech.



"Now is the time to start worrying! Not tomorrow!" he began. No one heard him, so one of his friends handed him a megaphone. *"We don't have that many years left to save the planet!"* he repeated, this time so loudly that everyone in the area could hear him. *"If the Earth's temperature continues to rise,"* he went on, *"by the end of the century, flood and droughts will kill thousands and force over two hundred*

million people to flee from their homes. Much of the world will become uninhabitable. Food production will collapse, and people will starve. Technology will not be able to save us. *Because it will be too late!*"

A few people in the crowd were clapping and nodding their heads. George's dad felt quite surprised. He'd been coming to these marches for years and years, handing out flyers and giving speeches. He'd got quite used to people ignoring him or telling him he was crazy because he believed that people owned too many cars, caused too much pollution, and relied too heavily on energy-consuming machines. And now, suddenly, people were listening to the environmental horror story he'd been talking about for so long.



"The polar ice caps are melting, the seas are rising, the climate is getting warmer and warmer," he went on. "The advances in science and technology have given us the power to destroy our planet! Now we need to work out how to save it!"

By now, a little group of Saturday shoppers had stopped to hear what he had to say. A small cheer went up from the people listening.

"It's time to save our planet!" yelled George's dad.

"Save our planet!" the campaigners shouted back at him, one or two of the shoppers joining in. *"Save our planet! Save our planet!"*

As a few more people cheered, George's dad lifted his arms in the air in a victory salute. He felt very excited. At last people were taking some notice of the terrible state the planet was in. He suddenly realized that all those years he had spent trying to raise public awareness were not lost after all. It was starting to work. All the eco-friendly groups had not protested in vain. When the cheers trailed off, George's dad was about to speak again when suddenly, out of nowhere, a huge custard pie sailed across the heads of the crowd and hit him right in the face.



There was a moment of shocked silence, and then everyone burst out laughing at the sight of poor George's dad standing there, with runny cream dripping down his beard. Wriggling through the onlookers, a group of boys dressed in Halloween costumes started running away from the square.

"Catch them!" shouted someone in the crowd, pointing to the band of masked figures sprinting away as fast as they could, laughing their heads off as they went.

George's dad didn't really mind—after all, people had been throwing things at him for years while he made his speeches; he'd been arrested, jostled, insulted, and thrown out of so many places in his efforts to make people understand the danger the planet faced, that one more custard pie didn't upset him very much. He just wiped the sticky goo out of his eyes and got ready to continue talking.

A few of the other green campaigners ran after the group of demons, devils, and zombies, but they were soon left behind, staggering and gasping for breath.

When the boys realized that the grown-ups had given up the chase, they came to a halt.

"Ha-ha-ha-ha," snickered one of them, ripping off his zombie mask to reveal the features of Ringo. His real face wasn't much more attractive than the rubber mask.



“That was great!” gasped Whippet, stripping off his black-and-white *Scream* mask. “The way you threw that pie, Ringo!”

“Yeah!” agreed an enormous devil, swishing his tail and waving his pitchfork. “You got him right on the nose!” Judging by his great size, it could be none other than Tank, the boy who just couldn’t stop growing.

“I love Halloween,” said Ringo happily. “No one will ever know it was us!”

“What should we do next?” squeaked Zit, who was dressed as Dracula.

“Well, we’ve run outta pies,” said Ringo. “So we’re going to play some *tricks* now, some good ones. I’ve got some ideas . . .”



By late that afternoon, the boys had given quite a few people living in their small town a bad fright. They’d shot an old lady with colored water from a toy pistol; they’d thrown purple flour over a group of small kids; and they’d set off firecrackers under a parked car, making its owner think they’d blown it up. Each time, they had caused as much havoc as possible and then scampered away very quickly before anyone could catch them.

Now they had reached the edge of town, where the houses started to spread out. Instead of narrow streets with rows of snug little cottages, the buildings got bigger and farther apart. These houses had long green lawns in front of them, with big hedges and crunchy gravel driveways. It was

getting dark, and some of these enormous houses, with their blank windows, columns, and fancy front doors, were starting to look quite eerie in the dim light. Most of them were dark and silent, so the gang didn't even bother ringing their bell. They were just about to give up for the day, when they came to the very last house in the town, a huge rambling place with turrets, crumbling statues, and old iron gates hanging off their hinges. On the ground floor, lights were blazing from every window.

“Last one!” announced Ringo cheerfully. “So let's make it a good one. Tricks ready?”

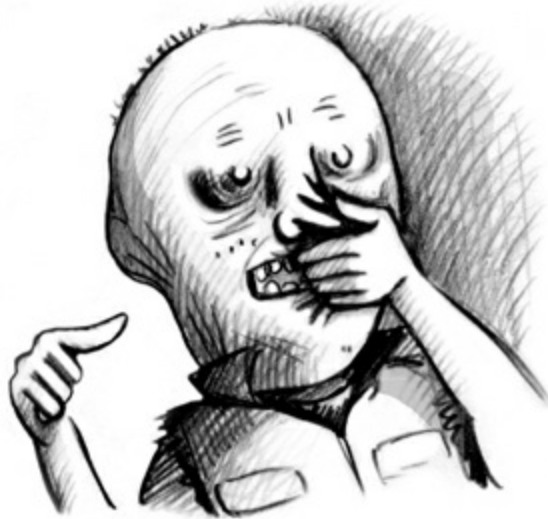


His band of boys checked their stash of trick weapons and hurried along behind him up the weed-covered driveway. But as they approached the house, they all noticed a strange eggy smell, which grew stronger as they approached the front door.

“Pooo-eeey!” said the huge devil, holding his nose. “Who did that?”

“Wasn’t me!” squawked Zit.

“He who smelt it, dealt it,” said Ringo ominously. The smell was getting so overpowering now, the boys were finding it hard to breathe. As they edged toward the front door—where the paint was peeling off the woodwork in ribbons—the air itself became thick and gray. Hand over his mouth and nose, Ringo reached forward and pressed the giant round doorbell. It made a sad, lonely clanging noise, as though it wasn’t used very often. To the boys’ surprise, the door opened a crack and fingers of yellowish gray smoke curled through the narrow gap.



“Yes?” said an unpleasant voice that was somehow familiar.

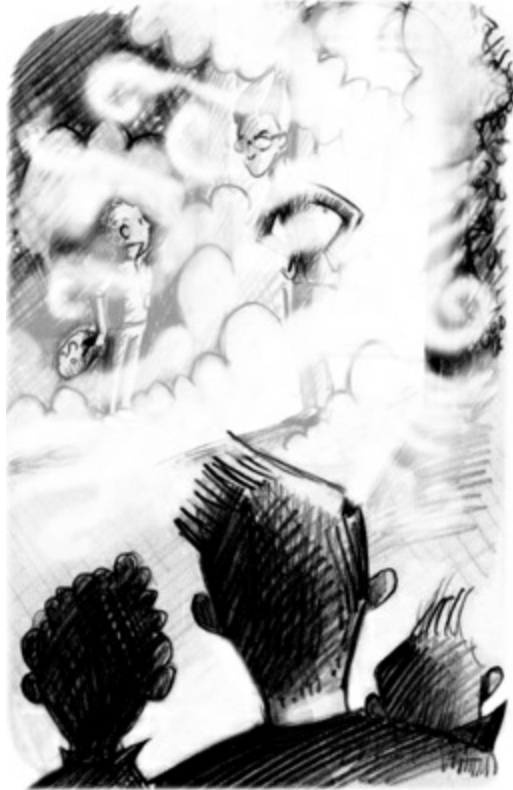
“Trick or treat?” croaked Ringo, almost unable to speak.

“*Trick!*” cried the voice, throwing the door wide open. For a fleeting second the boys saw a man wearing an old-fashioned gas mask standing in the doorway. Another second, and great clouds of stinky yellow and gray smoke rolled out through the open door and the man vanished from view.

“*Run!*” Ringo yelled. His gang didn’t need telling twice—they had already turned tail and were rushing back through the thick smog. Panting and wheezing, they staggered down the drive, through the gates, and onto the pavement. They ripped off their Halloween masks so they could breathe better after choking on the smelly smoke. But Ringo wasn’t with them—he had tripped in the driveway and fallen onto the gravel. He was struggling to his feet when he saw the man from the big house walking toward him.



“Help! Help!” he yelled. The other members of his gang stopped and turned, but no one wanted to go back for him. *“Quick!”* said Zit, who was the smallest. *“Go and save Ringo!”*



The other two just shuffled awkwardly and mumbled. The spooky man wasn't wearing a gas mask anymore, and the boys could almost make out his features through the clearing smoke. Ringo was standing up now, and the man seemed to be speaking to him, although the other boys couldn't hear what he said.

After a few minutes Ringo turned and waved to his gang. "Hey!" he shouted. "All of you! Get over here!"

Reluctantly the other three straggled toward him. Strangely, Ringo seemed very pleased with himself. Standing next to him, looking just a tiny bit sinister, was none other than Dr. Reeper.