

Martin and Emily's Wonderful Summer

A Frictional Adventure

CHAPTER 1

"I'm bored!" said Martin.

"Me, too!" said Emily.



"Now children, school has only been out for a week," said their mother.
"Surely you can't be bored so soon!"

"There's nothing to do," said Emily.

"All our friends are at camp," said Martin.

"Well," said their mother, "you're going to do something much better than camp! Next week you're going to visit your friend Albert. The week after that you'll stay with Jennifer."

"What's so great about Albert and Jennifer?" asked Martin. "We haven't seen them since they were little kids."

"You were little kids too back then," reminded their mother. "You all are almost the same age. Besides it's not just Albert and Jennifer who are exciting – it's where they live! Albert lives in Sticky World and Jennifer lives in Slippery World. Just wait till you see what that's like!"

"Sticky World sounds icky!" said Emily, "Who would want to live in a place where everything sticks together?"

"Yeah," agreed Martin, "and I bet Slippery World is slimy, too!"

"You're both wrong," said their mother. "Sticky World and Slippery World are just like here except the friction is different."

"What's friction?" asked Martin. He thought he knew, but he wasn't sure.

"Friction is the force that keeps things from slipping and sliding on each other," explained Emily. "Like sandpaper."

"What do you mean, like sandpaper?"

"Remember when we sanded that old rocking chair?" asked Emily.
"Remember how hard we had to push to slide the sandpaper up and down?"

"And it tore," said Albert, "and I got a splinter!"

"Right," said Emily. "Well, that's friction."

"Sticky World has a lot more friction than we do," said their mother, "and Slippery World has a lot less. That makes things very interesting, you'll see!"

"OK," said Martin, "but I hope I don't get another splinter!"

Describe what you think it will be like in Slippery World and Sticky World.

CHAPTER 2

A week later Martin and Emily were on the bus to Sticky World.

"Notice how slow the bus is going?" asked Martin. He was looking out the window at the trees inching past.

"Yeah," agreed Emily, "It's been doing that ever since we entered Sticky World. The motor sounds like it's working really hard, too!"

"I hope we make it!" said Martin.

Just then the bus driver called out, "Ladies and gentlemen, we're about to make our first stop in Sticky World. Mind your step as you exit the bus – things are a little different here from what you're used to!"

The bus came to a sudden, lurching stop. Emily and Martin looked out and saw Albert and his mom and dad standing on the sidewalk. They waved to them. Then they got their luggage out of the rack and ran to the front of the bus to be the first ones off.

"Careful!" said the bus driver, but Martin and Emily weren't paying attention. They jumped off the bus and tried to run to their friend, but as soon as their feet touched the pavement they stuck there. Martin and Emily fell over and lay on the sidewalk, looking up at Albert who was coming to them as fast as he could.



There was something strange about the way Albert was moving. For one thing, he wasn't moving very fast. Also, he was picking his feet up awfully high with every step he took.

"Hi!" said Albert, when he finally got close enough to talk without yelling. "I'm glad you made it! Did you have a good trip? Here, let me help you up." Albert held out a hand to Emily and yanked her to her feet. Then he did the same thing for Martin.

"Don't be embarrassed about falling down like that," Albert said.
"Everybody does it the first time. Sticky World takes a little getting used to."

"You see," he continued, "Sticky World is just like Normal World where you come from, except for one thing: the force of friction is much greater here than in Normal World."

"Yeah, Mom warned us about that," said Martin. "She said I might get a splinter!"

"A splinter?" Albert looked confused.

"Don't mind him," said Emily, "He got a splinter once sanding a chair with sandpaper and now he's convinced that..."

"Oh, we don't use sandpaper here," Albert interrupted. "We just use an old rag or something and it works fine. Everything sticks to everything else in Sticky World."

"I get it!" said Emily. "That's why our feet stuck to the pavement when we got off the bus."

"And we tripped!" said Martin. He was inspecting a scrape on his elbow that he'd gotten when he fell.

"I saw," said Albert. "I hope you didn't hurt yourselves. Around here you have to learn to walk like this." And he showed them how to pick their feet straight up so they wouldn't get stuck.

"This stinks!" said Martin. He said it softly, but Albert heard him anyway.

"Oh, no, it doesn't!" he said. "Wait till you see all the neat things you can do in Sticky World!"

CHAPTER 3

As soon as Martin and Emily had met Albert's parents they all piled into their car and took off for home. On the way, Martin and Emily noticed that the car was going awfully slowly even though the engine was roaring and the road was perfectly flat. They were getting sadder and sadder – what fun could you have in a world where everything stuck together like this?

Albert's father tried to cheer them up. "How do you like our new car?" he asked. "We're getting great mileage – three miles to the gallon on the highway!"

"That's nothing," said Martin, "My dad's hybrid goes 45 miles on a gallon of gas."

"Oh, but that's in Normal World," said Albert's father. "Around here most cars don't do much better than one mile to the gallon."

"What a ripoff!" said Emily. "I bet you pay the same for gasoline as we do, but you don't get as much out of it. That's not fair!"

"You're right about that," Albert chimed in. "A gallon of gasoline costs about the same here as in your world 'cause there's just as much energy in it. But here we seem to lose a lot of the energy somehow."

"Oh, we don't lose it," said his dad. "We just don't use it very efficiently here."

"A lot of the energy in the gasoline goes into heat," Albert's mother explained. "That's what happens when there's friction. Things slow down and their energy turns into heat."

"I don't get it," said Emily. Sticky World was getting stranger by the minute. She was beginning to feel homesick already.

"I think I understand," Martin said. "It's like when it's really cold and you've lost your gloves..."

"You're always losing your gloves!" said his sister.

"No, it was just that one time. Anyway, when your hands get really cold like they did that time you can rub them together to warm them up."

"Very good, Martin!" said Albert's mom. "That's a good example of what happens when friction turns motion into heat!"

"And in Sticky World it really works well!" said Albert. "Try it!"

So Martin and Emily tried rubbing their hands together. They were surprised at how hard it was to move them against each other. After a very short while, though, they had to stop.

"Wow!" said Martin. "It feels as though my hands are burning up!"

"I bet you could start a fire real easily here by just rubbing two sticks together," said Emily.

"Oh, yes," said Albert, "we do that all the time. We never use matches in Sticky World."

What does friction change the energy of motion into?

CHAPTER 4

After what seemed like an hour they finally got to Albert's house. As they pulled into the driveway, Martin and Emily could see that it was a very pretty house, made of brick and two stories high with an extra room way at the top where the chimney came out. There were boxes under every window full of red and yellow flowers, and a tall oak tree in the front yard.

"That's my room," said Albert, pointing to the little room at the top. "Watch how I get to it."

Albert walked over to the house and then a surprising thing happened! Albert walked right up the wall, using his hands and feet like Spiderman! Martin and Emily were amazed!

In no time at all, Albert had reached the roof of the house. He walked along the wall sideways until he came to his room. Then he opened the window with one hand, holding on with the other. He crawled in, turned around, and reappeared at the window, smiling down at them and waving.



"How did you do that?" yelled Emily. "What are you, some kind of acrobat?"

"Anyone can do it," Albert called down. "Come on, you try!"

So they did. It was a little scary at first, but Emily and Martin found that it was really pretty easy to walk up and down walls in Sticky World. It wasn't quite as good as being Spiderman, but almost. Their hands and feet did slip a little on the wooden walls of the house, but if they found rough spots they could hold on to them and pull themselves up. They spent the rest of the afternoon practicing, and pretty soon they were almost as good as Spiderman himself.

Maybe Sticky World wasn't going to be too bad, after all!

Write a summary of Chapter 4.

CHAPTER 5

The week had gone by incredibly quickly.

"Goodbye," said Emily. "I had a wonderful time!"

"Me, too!" said Martin. "It's going to feel strange going back to not sticking to things."

"I can't imagine what that's like," said Albert, who had lived his whole life in Sticky World. "I'd probably fall down all the time."

"That may happen to us, too," said Emily. "Remember, we're not going home yet. We're going directly from here to our friend Jennifer's house. She lives in Slippery World where there's practically no friction at all. I wonder what that will be like."

"Here comes your bus," said Albert's mother. "Do you have all your stuff with you? Do you have your tickets?"

Martin and Emily got on the bus. "Have a good time," said Albert's mother. "I'm sure you'll find interesting things to do in Slippery World!"

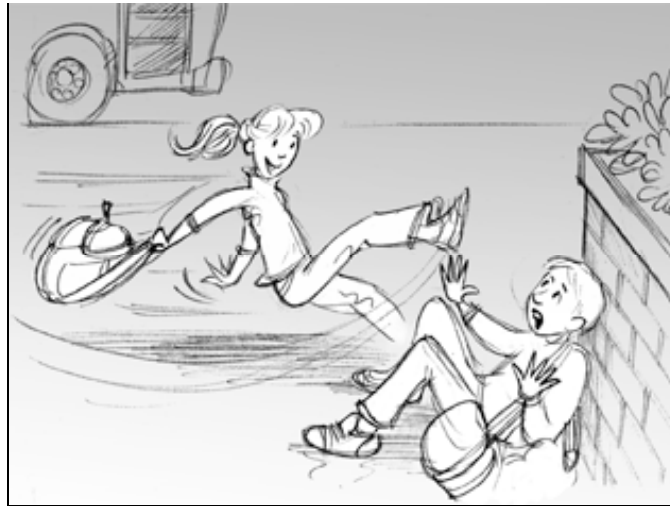
CHAPTER 6

"I'm going to be really careful getting off the bus this time," said Emily. They had just stopped at Slippery World. Emily and Martin could see Jennifer waving at them madly. She was trying to say something, but they couldn't hear her through the bus window.

"Watch your step!" said the bus driver, as Martin stepped out of the bus. "It's kind of slippery out there!"

Oops! Martin was careful, but not careful enough. His feet slipped out from under him and he sat down rather suddenly. From the bus, the ground where he was sitting had seemed perfectly level, but now that he was sitting on it he found that it sloped slightly. He started to slide downhill, going faster and faster, until he banged up against a wall and stopped. The experience reminded him of the very first time he had been on skis. He fell at the top of the bunny slope and slid all the way down to the bottom.

"Look out, here I come!" Emily yelled. She had fallen down, too, and now she was sliding right at Martin. She slammed into the wall beside him. "Oof!" she said.



"Boy, this place is really dangerous," said Martin. "I wonder how Jennifer can stand it!"

"Well, you can ask her," replied Emily, "'cause here she comes."

Jennifer was gliding over to them. She was wearing ordinary shoes, but she seemed to be ice skating. It looked very graceful and easy. It also looked like a lot of fun!

"Welcome to Slippery World!" said Jennifer. "I'm sorry you fell. There's a bit of a hill, I'm afraid. They really should move the bus stop. The tourists are always sliding up against this wall. Are you OK?"

Emily's arm was scraped where she had hit the wall, but she said, "No, I'm fine." Martin said, "I guess we're going to have to learn to walk all over again."

"It's not hard," said Jennifer. "You just dig your heel in like this and push off." And she demonstrated, gliding away just as if she were on skates. "The thing is," she added, over her shoulder, "there isn't much friction here, so you have to pull or push on something if you want to stop or change direction." She demonstrated by digging in her heel again, making little ruts in the ground and coming to a stop.

"It's as though you're wearing heelys!" said Emily.

"What are heelys?" asked Jennifer.

"You don't know what heelys are?" Martin was amazed. "They're shoes with wheels on them so you can roll places."

"Why would you need wheels," asked Jennifer, "when you can just slide?"

"Where we come from," Emily tried to explain, "friction keeps you from sliding. The wheels on the heelys roll and that makes it much easier."

"Oh, now I remember," said Jennifer. "We learned about friction in school, but I didn't think it was real! It must be very strange to slow down all the time, even when you're not going uphill."

"You get used to it," said Martin.

Martin and Emily practiced "skating" without skates in Slippery World. "You better learn to do it," said Jennifer, "'cause this is how we're getting home."

"You mean you didn't drive here?" asked Emily.

"No," said Jennifer. "My house and this bus stop are at about the same level and there's a valley in between, so we can coast all the way."

"I don't understand," said Martin. "What does a valley have to do with it?"

"You'll see," said Jennifer with a smile.

CHAPTER 7

Martin and Emily practiced and practiced until they were pretty good at sliding around in Slippery World. To get moving they learned how to dig the side of their foot in and push off onto the other foot. To turn, all they had to do was lean one way or the other. Stopping was the hardest. When they tried to dig their heels in the way Jennifer had done, they would lose their balance and sit down very suddenly. And then they would continue sliding until they hit something. It took quite a while for them to get it right, but after an hour or so they were able to slow down and stop without falling – most of the time, anyway!

“OK,” announced Jennifer, “I think it’s time for us to go home now. Follow me.” Jennifer pushed off and slid slowly down the sidewalk, looking around to make sure that Emily and Martin were following her. When she got to the corner she dug in her heels expertly, stopped, and waited for them to catch up.

“This street leads to my house,” she told them. “It dips down a bit, so you’ll get going faster and faster, but don’t worry – after a while it goes up and that will slow you down. Just keep both feet on the ground, don’t try anything fancy, and you’ll coast to my house with no effort at all.”

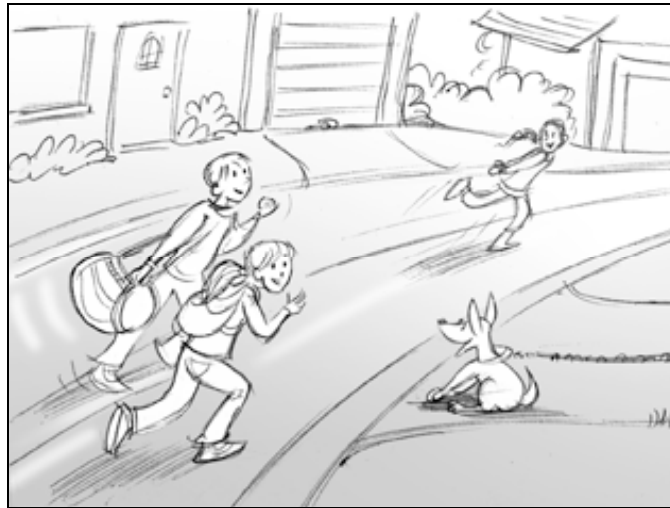
“How far is it?” Martin wanted to know.

“About three miles.”

"And we can coast the whole way?"

"Sure! Sometimes we'll be going pretty fast, like down in the valley, and other times we'll go more slowly, but we'll get there. As long as you don't hit anything!"

And with that Jennifer pushed off just a bit and headed slowly down the street. Martin and Emily followed her cautiously. Although they hadn't noticed it before the street sloped downward just a bit, and without even trying they found that they were going faster and faster.



"This must be what Jennifer meant when she talked about going into the 'valley,'" said Emily.

"It's not much of a valley!" said Martin.

"It's not much, but it's enough to get us going pretty fast, anyway!" said Emily. Indeed, she and Martin were going so fast that she could feel the wind in her face. She started to worry that she was going to hit a tree or something.

Emily was just about to try digging in her heels to slow down, when the street started to slope upward. As before, the slope was almost unnoticeable, but the little hill was enough to slow them down.

"Whew!" said Emily. "That was scary!"

"I hope we make it over the top of this hill," said Martin. "I don't think I know how to skate uphill around here." Jennifer was pretty far in front of them by now, and wouldn't be any help if they stopped and started to slide back down the hill. But that didn't happen. By the time they reached the top of the hill they had slowed almost to a walk, but then they were over it, and as they headed down the other side they started to speed up again.

And that's the way it went all the way to Jennifer's house. When they were going downhill they went faster and faster, when they went uphill they slowed down, and when they were on level ground they just slid along at a constant speed. It was a lot of fun and they were almost sorry when, turning a corner, they came upon Jennifer standing to one side of the street in front of a low single story house. She clapped her hands as they skated up, looking at them with a big smile on her face.

CHAPTER 8

They were moving pretty slowly as they approached Jennifer's house, but even so Emily and Martin nearly went sailing past it. "Dig in your heels!" yelled Jennifer. "Otherwise you'll coast right into the next town!"

"That was neat!" said Martin as he awkwardly came to a stop several feet beyond the spot where Jennifer stood.

"We never even had to skate," said Emily, who had grabbed Jennifer's hand as she slid by. "We just coasted over all those hills."

"I know," said Jennifer. "Pretty cool, huh? Still, it's kind of tiring. It's a hot day – why don't we all go inside and my mom will make us an ice cold lemonade."

Jennifer's mom was small and pretty. With her long brown hair and brown eyes, she looked like an older copy of Jennifer herself. She must have seen the kids coming down the street because the lemonade was already on the table. Her voice was soft as she asked Martin and Emily how they were enjoying Slippery World so far. They told her how much fun they had had sliding home from the bus stop.



But Emily, as always, had a question. "I still don't understand," she said, "how come we could coast the whole way here? We could never have done it at home, even on our bikes. Not without peddling."

"That's because the bus stop is higher than any other point along the road," explained Jennifer's mom. "So starting from there you had enough stored up energy to make it all the way here without working at it."

"There you go with that 'energy' again!" said Martin. "That's all Albert could talk about, too. Energy, energy, energy. What is energy, anyway?"

"It's simple," said Jennifer's mom. "Basically, there are two kinds of energy – the energy you have when you are moving and the energy you have when you're at the top of a hill. Oh, and heat energy, too, of course."

"What about electricity?" said Jennifer. She had just learned about electricity in school that year and she was proud to show off her new knowledge.

"Well, yes, there's electricity," said her mom, "and other forms of energy, too, but to answer Martin's question we only need to think about those three: **kinetic energy**, which is due to motion, **potential energy**, which you get by going up a hill, and **heat**."

"So, let's see..." said Martin. He was scrunching up his face as he thought about energy. "At the bus stop, before we started, we had no kinetic energy 'cause we weren't moving yet. But..."

Emily chimed in, "But we had lots of potential energy, right? Because we were at the top of a hill."

"It isn't a very steep hill," said Martin. "I hardly noticed it at first."

"Remember how you slid when you got off the bus?" Jennifer reminded them. "It doesn't take much of a hill to get you sliding all over the place in Slippery World!"

"OK, OK," said Martin. He was embarrassed about falling out of the bus and he wanted to change the subject. "So when we slid downhill we were turning potential energy into kinetic energy, right?"

"Exactly!" said Jennifer's mom, beaming. "And when you went uphill and slowed down you were changing kinetic energy back into potential energy. You always keep the total amount of energy you started with."

"Kind of like the rechargeable batteries in my iPod!" said Emily. "When we go uphill we're storing energy that we can use later on."

"But what happens if we hit a hill that's too big?" asked Martin. "What if we can only get partway up?"

"That will happen any time you try to get higher than you were originally," said Jennifer's mom. "Luckily none of the hills between the bus stop and here are higher than the bus stop itself, so you had enough potential energy to get over all of them."

"OK, I get it," said Martin, "but there's still one little thing I don't understand. Why can't we do this kind of thing in Normal World, where I come from?"

"Ah, that's where the heat comes in!" said Jennifer's mom. "Remember, heat is energy, too. In Normal World there's a lot more friction than there is here, and friction is the force that turns motion into heat. So in Normal World instead of using all your kinetic energy to go up hills you lose a lot of it by making heat. Even if there are no hills you slow down because your motion is heating things up. That's why you have to keep peddling your bike instead of just coasting everywhere."

"It's even worse in Sticky World," said Emily. "There you really have to work to keep moving at all."

A thought popped into Martin's head. "They make a lot of heat there, too!" he said, excitedly. "Even rubbing your hands together practically makes them burn up!"

"That's because there's so much friction in Sticky World," said Jennifer's mom. "Try rubbing your hands together here."

Martin and Emily rubbed their hands together. Their hands felt slippery and no matter how hard they rubbed them they didn't warm up. It was a weird feeling.

"See?" said Jennifer, "No friction, no heat!"

"So how do you guys make fires?" asked Emily. "Do matches work in Slippery World?"

"Ordinary matches don't," said Jennifer, "but we have specially sensitive ones that light if you rub them on sandpaper. Luckily there is some friction here, otherwise we couldn't use any kind of match."

"And not only that," said Jennifer's mother. "If there were no friction at all nothing would ever stop moving. Imagine that!"

Write a summary of Chapter 8.

CHAPTER 9

"It's been a lot of fun," said Martin, "and I'm really going to miss you, but..."

"I know," said Jennifer, "I'm sure you miss your parents, too."

"It's not just that," said Emily. "There are a lot of cool things about a world with practically no friction, but ... I don't know..."

"It's just not the same." Martin said. "I mean, it's cool to be able to skate everywhere, and those slides in the park are great, but I'm really looking forward to having my dinner plate stay where I put it."

"You know what?" said Emily, as the bus came into view. "There's just no place like home."

THE END

Would you rather visit Sticky World or Slippery World? Why?