

18.2 That's Not Plastic, It's a Polymer!

Kailey tells Sam about car shopping with her mother, and the car salesman touting a car made from polymers, turning into a tutoring session that enabled Kailey to highlight her knowledge of chemistry, and left the car salesman more aware of his product.

Kailey: Sam, I've got to tell you a funny story about when mom and I went car shopping last night.

Sam: Oh my. I went car shopping with my dad and it was anything but funny. It was a total nightmare. Let me tell you what happened. Even before... *(gets interrupted by Kailey)*



Kailey: Hang on Sam – Ever hear the term egocentric?

Sam: Is that a new model of car?

Kailey: Never mind. But as I was saying, we went car shopping, and as we were admiring this car, we tapped on the fender to see if it was made of metal, or made of plastic. You see, mom had an accident last year – just a fender bender – but the fender didn't dent, it crinkled along the whole left side of the car, the front bumper, grill, and almost everything in the front. So now she wants a car made of metal.

Sam: So, the car you were tapping on, was it plastic or metal?

Kailey: Well, mom turns to me and says with disgust in her voice "It is made of plastic" and scrunches up her face. Well, one of the car salesmen is close by and trots over and says "Ma'am" which if you know my hip and trendy mother, she hates being called "Ma'am." So he says "Ma'am, this car body is not plastic, it is a polymer."

Sam: A "polymer?"

Kailey: *(with a sassy and arrogant voice)* Right, a "polymeeeeeeeeer!"

Sam: So he had read the sales manual and pulled out one of his talking points, but didn't have a clue about what he was saying?

Kailey: That's right Sam – no clue. So I figured this was a learning moment for him.

Sam: *(alarmed and showing consternation)* Uh-Oh. What did you do?

Kailey: I decided to share some of my chemistry knowledge with him. So I began by asking him a question, which was "Is it a natural polymer or a synthetic polymer?"

Sam: Hey, I think I know the answer to that, but what did he say?

Kailey: Well, he said nothing, but it got his attention. And my mom started to look at me cross-eyed because she has seen me go into the Einstein mode before. So I said "Well, a natural polymer is like shellac, amber or natural rubber, and a synthetic polymer is like synthetic rubber, bakelite, neoprene, polystyrene, PVC – you know, as in PVC pipes for plumbing, nylon, polyethylene, polypropylene and others."

Sam: So what happened next?

Kailey: Well, the guy quickly started to talk about the engine size, and my mom cut him off and said to me with emphasis "So this "polymer" car body is just a type of "plastic," right? And I said, correct.

Sam: And?

Kailey: Well, at this point the car salesman realized the gig was up, and he was really nice about it and asked me to tell him more about polymers, so he wouldn't put his foot in his mouth the next time. He said he went to college, but didn't know beans about polymers and asked if I would give him the short course.

Sam: Nice! So you told him and your mom about polymers?

Kailey: Not so much – mom went off to look at other cars. But here are some tidbits I shared with the guy. First, I said, a polymer was simply a large molecule, made up of repeating structural units. For example, most plastics are composed of repeating carbon atoms in a long chain, and the plastics differ by what is connected to this backbone. And we can create synthetic polymers by a process called polymerization to combine many small molecules called monomers into long chains using covalent bonds.

Sam: Ok – I still follow you and get the covalent bonding thing.

Kailey: I hope you do as we talked about covalent bonds in chemistry last month. So then I gave him some information that he could relate to car fenders made of polymers. I told him that the physical properties of polymers were dependent on the length of the polymer chain. For example, if you want a polymer that is more resistant to higher temperatures and more impact resistant, you need a longer chain.

Sam: So a polymer like polyethylene has much shorter chains than something like PVC correct?

Kailey: Right, and therefore PVC is much more resistant to higher temperatures. Ok. So at that point, I figured his head was probably full, and mom was swinging by with looks that said "let's skedaddle" so I thanked the guy and we zoomed out of there.

Sam: Hey, that was cool - you could use your chemistry knowledge again - in the real world, and I bet it impressed your mom.

Kailey: Yes, she thanked me for saving her from the superficial “polymer” sales talk, and we went for ice cream cones on the way home.

Sam: Cool. But I have a question for you. You said, natural or synthetic rubber was a polymer. I have bunch of rubber bands lying on my desk at home and after a year, some of them are disintegrating. What’s happening? Is the temperature of my room too high or what?

Kailey: Here is what I would guess based on what I know about something called polymer degradation and in this case perhaps “chain scission.” Let’s go back to the beginning where we said polymers are simply long chain molecules. And scission means breaking bonds. So chain scission simply means something is breaking bonds in those long chains, and if that happens the long molecule breaks down into shorter pieces, or changes color, shape, or perhaps loses tensile strength – the force needed to pull something until it breaks. And I bet those rubber bands would break a lot faster than new ones, right?

Sam: Right! I tried to use them to hold some papers together, but they snapped every time. So what caused my rubber band to disintegrate?

Kailey: Well it might be ozone. Some polymers are affected greatly by ozone cracking the double bonds that hold the repeated units together. There is actually a science lab we did in middle school where we stretched rubber bands around a jar and exposed them to indoors air, outdoors air, and in various places to see how it affected the rubber band.

Sam: Cool – what happened?

Kailey: Can’t tell you – I heard you were doing that lab in Chemistry this year, so I don’t want to spoil your fun.

Sam: That’s OK. With what I know now, I bet I can be the top dog in terms of predicting what is going to happen. I will look like a Rhodes Scholar thanks to your little story and information.

Kailey: You’re welcome Sam – Just glad to help my bud. Now, perhaps a reward of ice cream cones is in order?

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