GABRIELLA HARPER: You're listening to Brains On where we're serious about being curious.

[MUSIC PLAYING]

(SINGING) Buckled in the back seat near and far. It's a Brains On road trip in the car.

MOLLY BLOOM: We are just past the halfway point of the Brains On road trip. So the answer to your next question--

GABRIELLA HARPER: Are we there yet?

MOLLY BLOOM: No, but we can listen to a podcast.

GABRIELLA HARPER: How many do you have?

MOLLY BLOOM: As many as are available. This car has Wi-Fi.

GABRIELLA HARPER: Cool.

MOLLY BLOOM: And because we're in this sleek, aerodynamic car, think of how much faster we're going to arrive than we would have 50 years ago.

GABRIELLA HARPER: But still, my back is sore from sitting so long.

MOLLY BLOOM: No problem, I'll turn on your in-chair massage.

GABRIELLA HARPER: Oh, nice. Hmm. How about you wake me up when we get there?

MOLLY BLOOM: OK, but before you start napping, you still have to help out with today's episode.

GABRIELLA HARPER: All right. I'll just shut off the massage for a few minutes. OK, ready.

[MUSIC PLAYING]

MOLLY BLOOM: You're listening to Brains On from American Public Media. I'm Molly Bloom. And joining me again is our road trip co-host, Gabriella Harper. Hi, Gabriella.

[HONKING]

GABRIELLA HARPER: Hey, Molly.

MOLLY BLOOM: Today, we're looking at car design.

GABRIELLA HARPER: The look and feel of cars.

MOLLY BLOOM: Everything in your car, from the position of the armrest to the way the glove box opens.

GABRIELLA HARPER: Even the sound your car makes.

MOLLY BLOOM: All of it has been carefully thought out and designed, but that has not always been the case.

GABRIELLA HARPER: One of the earliest mass-produced cars was Henry Ford's Model T. When they first started rolling off the assembly line in 1908, design was definitely an afterthought.

MOLLY BLOOM: To keep the price down and make them quickly, Ford Model Ts all looked the same.

MAN: Any customer can have a car painted any color that he wants, so long as it is black.

GABRIELLA HARPER: Still, the wow factor was huge. Just having cars on the roads where there used to be only, horses and carriages, that goes a long way. And by a long way, I mean about a decade.

MOLLY BLOOM: After people began to see cars as less of a luxury and more of an everyday item, they wanted more options. You know, maybe not a black car.

GABRIELLA HARPER: Maybe something that drove a little faster, or better yet, a little safer.

MOLLY BLOOM: Which brings us to this question from Edon in Evanston, Illinois.

EDON: My question was, what part are cars made out of?

MOLLY BLOOM: Whew! What are the parts that make a car? That's a big one. We talked about some of the parts under the hood in our episode about engines.

GABRIELLA HARPER: That actually kicked off this road trip series. So check it out if you haven't already.

MOLLY BLOOM: But when it comes to design, innovation comes out of need. Take race drivers. The very first Indianapolis 500 race was in 1911.

MAN: Gentlemen, start your engines!

[ENGINE REVS]

MOLLY BLOOM: Up to that point, two people sat in every race car, one focused on the road ahead and drove the car, while the other checked out the competition and looked to see if it was safe to change lanes. A driver by the name of Ray Harroun decided he could lose the weight of the passenger and replaced him with the first rear view mirror.

JIM: Say, Ray, where are you going? Wait for me, Ray.

RAY: Sorry, Jim. Win or lose, I'm going solo. See you at the finish line.

MOLLY BLOOM: Harroun and his rearview mirror took home the checkered flag in that race.

GABRIELLA HARPER: Mary Anderson patented the windshield wiper all the way back in 1903 during a stormy streetcar trip. Her idea didn't catch on at the time, sadly, and her patent expired.

MOLLY BLOOM: But another woman, Charlotte Bridgwood, took on the weather problem. And in 1917, she patented the first electric windshield cleaner. Her design used rollers instead of wiper blades.

WOMAN: Clean windows help keep me and my little passengers safe.

MOLLY BLOOM: Charlotte passed her inventor's habits down to her daughter, Florence Lawrence. Historian John Heitmann says Florence helped refine another safety feature.

JOHN HEITMANN: Well, it was around 1920 that I think a Hollywood woman, a Hollywood star ended up playing a big role in the developing of the first turn signals.

MOLLY BLOOM: Oh yeah, in addition to being an inventor, Florence Lawrence was also a silent film star.

JOHN HEITMANN: And turn signals for the longest period of time in certain cars, and particularly in certain countries like Britain, weren't electric turn signals. They were levers that when you hit the turn signal switch, a lever popped out of the side of your car that indicated you were turning. And those are called trafficators. And they're pretty cool soon.

GABRIELLA HARPER: Soon, design decisions moved beyond safety. Personal choice and comfort come into play. The car stereo is introduced in 1930, and people wanted to show off their cars in more than basic black.

JOHN HEITMANN: Colors are so important. Until the 1920s, colors are pretty limited. After the 1920s, we have new paints and we get into a very colorful world of motoring, the reds, the yellows, the greens, and then after World War II, the pastels, and two-tone cars and three-tone cars in the 1950s.

MOLLY BLOOM: That's also about the time we see cars with bigger and bigger tail fins and rocket-shaped tail lights.

GABRIELLA HARPER: Designers are always borrowing from popular culture. This is about the time the world becomes obsessed with flying into space, and they want their cars to reflect those space-age dreams.

MAN: 4, 3, 2, 1, 0. Take off.

MOLLY BLOOM: Hey, Gabriella. This looks like a good place for a pit stop. We need some gas. Maybe you could play your conversation with Jay Shuster while we refuel and pick up some snacks.

GABRIELLA HARPER: Oh, good idea. Jay has been around car design his whole life. He grew up in Detroit, where his dad designed cars. Jay's interests turned from cars to animation.

MOLLY BLOOM: And back sort of. Jay is a designer from Pixar, and he's worked on the "Cars" movies. That means he's had to study many different eras of car design.

GABRIELLA HARPER: He's helped come up with a lot of the characters in the series, including this year's "Cars 3." I got a chance to ask him a few questions a few weeks ago. OK, be right back.

Hello, Jay.

JAY SHUSTER: Hi, Gabriella. How are you?

GABRIELLA HARPER: Yeah, I'm so excited to talk to you.

JAY SHUSTER: Well, I'm happy to be here too. Thank you for having me.

GABRIELLA HARPER: Did your dad help in the design for the first movie?

JAY SHUSTER: He's not an official Pixar employee, but just from how he inspired me as a kid, he-- yeah, I would say he did help in the design of the first film. He doesn't have a credit in the film, but it was really an amazing experience coming to Pixar for the first time. I had so much stored up kind of knowledge from growing up in Detroit that when I got the job here, it just kind of all came out at once onto the page.

GABRIELLA HARPER: Did you get to design the cars from scratch or were you drawing someone else's ideas?

JAY SHUSTER: So on "Cars 3," I was a production designer, which means I drew a number of the cars myself. As a production designer, I was responsible for all the design of all the characters that you see on the screen, though I had a handful of folks working with me on other designs as well. I think my proudest moment on "Cars 3" was the design of Jackson Storm. I think he's a really cool looking car.

GABRIELLA HARPER: Yeah, I like him too.

[MUSIC PLAYING]

WOMAN: Jackson Storm is part of the next generation of high-tech racers.

MAN: A rookie sensation!

MAN: Jackson Storm!

MAN: Jackson Storm!

WOMAN: Jackson Storm's in a class of his own.

[CAR ZOOMING]

[TIRES SCREECHING]

GABRIELLA HARPER: He looks fierce.

JAY SHUSTER: Yeah, he looks fierce. It's exactly right. And that's what exactly we were going for in his shape and his color and his graphic. Everything about him had to communicate that aggressiveness. And that was really fun to work on.

GABRIELLA HARPER: What types of cars inspired the characters?

JAY SHUSTER: Well, on any given day, the walls of the art room, it's a big space that has these big, black boards, they are about 4 by 8 feet, that we pin stuff up on. Basically, it's like a wallpaper of all kinds of different cars, and that'll change on a daily basis. If we're working on Storm, that room could be full of just the most aggressive race cars the world has to offer plus different kind of graphic treatments and paint schemes and things like that.

And we get most of our inspiration for these character designs by just doing a lot of research. We did a ton of research for "Cars 3" because we do actually do some time traveling in our film. We have these really beautiful flashbacks to Doc Hudson racing. If there's somebody in the audience who knows what that era, the mid to late '50s era looks like, we wanted to really nail what those cars were. So we had to make sure that everything looked correct.

You never know what's going to inspire the next design of a character or of a building. In fact, I remember one of the research trips that we took back to Detroit, because Detroit is-- it was basically one of the birthplaces of the automobile and has such a rich history. And just going back into these warehouses full of old, dusty cars and old rusting gas pumps and hood ornaments and badges and just all this kind of ephemera that you find in car culture.

We'll even go out into our own parking lot here at Pixar. And that's the great thing about these car designs, you can go out anywhere and just really find inspiration on the street.

MOLLY BLOOM: OK, we're gassed up.

GABRIELLA HARPER: Snacked up.

MOLLY BLOOM: And buckled in. Gabriella, I have a great road trip game.

GABRIELLA HARPER: Oh, I want to play.

MOLLY BLOOM: It's time for the mystery sound.

GABRIELLA HARPER: Mystery sound.

MOLLY BLOOM: Here it is.

[WATER SLOSHING]

OK, that was a mysteriously long mystery sound. What is your guess?

GABRIELLA HARPER: I think it was like a thunderstorm.

MOLLY BLOOM: Oh.

GABRIELLA HARPER: Because I could hear like rain patting down on the cement.

MOLLY BLOOM: That is a great guess. We will be back after the break and see how close you are.

[MUSIC PLAYING]

GABRIELLA HARPER: Our next Verses episode is coming up in July. And we want to know which side you're on.

MOLLY BLOOM: Which do you think is cooler, deep sea or outer space?

GABRIELLA HARPER: Send your argument to Hello@BrainsOn.org.

MOLLY BLOOM: It's your answers, questions, and mystery sounds that make this show possible.

GABRIELLA HARPER: And in order to thank all the kids who share their energy and ideas with us, we started the Brains Honor Roll.

MOLLY BLOOM: Listen for the most recent group to be added to this illustrious list at the end of the show.

GABRIELLA HARPER: And if you're looking for some more fun to keep you busy in the car, you should subscribe to our newsletter.

MOLLY BLOOM: If you do, we'll send you some downloadable activity sheets dreamed up by the Brains On team that will help you pass the time in style.

GABRIELLA HARPER: You're listening to Brains On from American Public Media. I'm Gabriella Harper.

MOLLY BLOOM: And I'm Molly Bloom. And today, we're talking about car design. It's something that anybody who's ever been in or seen or heard a car has come in contact with.

GABRIELLA HARPER: But is it the same for all cars? Or should I say trucks? Cass from Bangalore, India, wrote in with this even bigger question.

CASS: Hi, my question is, how are massive trucks different to cars?

MOLLY BLOOM: For the answer to this question, we have to make another pit stop. But don't worry, it's on the way.

GABRIELLA HARPER: Where are we?

MOLLY BLOOM: You'll See. Hang on.

MARC SANCHEZ: Hi, guys. Come on in and get yourself hydrated. Oh, and are you ready to rumble?

MOLLY BLOOM: Brains On Producer Mark Sanchez checked out the monster truck scene recently.

MARC SANCHEZ: Yeah, and it's super exciting, giant trucks jumping 30 feet into the air, popping wheelies, doing donuts, and crushing everything in their path!

GABRIELLA HARPER: Sounds fun.

MARC SANCHEZ: Yes, exactly what Rosalee Ramer thinks.

ROSALEE RAMER: I'm Rosalee Ramer, the driver of Wildflower Monster Truck. And I'm the world's youngest professional female monster truck driver and also a mechanical engineering student at Georgia Tech.

MARC SANCHEZ: I thought Rosalee would be the perfect person to answer Cass's question because she's been a professional monster truck driver since she was 14. 14! Her dad is a driver too, so Rosalee basically grew up at monster truck jams, fixing trucks and taking in all the action. Not only does she know every part screwed on to her truck inside and out, she's also helped come up with some modifications to suit her aggressive driving style, which I'll get to in a second, but not before we address the big, obvious difference between monster trucks and cars.

GABRIELLA AND MOLLY: The tires!

MARC SANCHEZ: Yeah, those things are huge. Each of those mammoth tires stands around 66 inches tall. To put it another way, that's 5 feet 6 inches tall. Or to put it another way, that's as tall as Rosalee herself. Before we get into what's so special about these behemoth tires, we need to talk about hydraulics. Basically, it's the use of liquid to transmit power. And this idea is all around us, from roller coasters to rocket ships.

Hydraulic power is in every car and monster truck. In the case of Rosalee's tires, hydraulics are used to push her wheels left or right or both.

ROSALEE RAMER: My front steering is hydraulic and it's through my steering wheel. So I turn my front wheels with my steering wheel.

MARC SANCHEZ: Just like a regular car.

ROSALEE RAMER: And then my rear wheels are controlled by a toggle switch. So I actually use a toggle switch right behind my shifter with my right hand to turn the rear wheels. And that sends a signal to an electric motor, which basically turns the hydraulic pump to push my rear wheels either left or right, depending on which direction I push the toggle switch.

MARC SANCHEZ: With a set of rear wheels that can turn independently of the front wheels, her monster truck can make super tight turns, which comes in handy if you're doing tricks or spinning out donuts.

MOLLY BLOOM: All right, bigger tires and front and back wheel steering. What else?

MARC SANCHEZ: Well, one of the biggest differences is the design of a monster truck's chassis.

GABRIELLA HARPER: That's the frame cars are built on top of.

MARC SANCHEZ: Yeah, a chassis is basically pieces of steel that have been welded together to form roughly a rectangle. Once a chassis is in place, you can add tires, mount an engine, bolt on floorboards, and attach doors. Here's Rosalee again.

ROSALEE RAMER: So a monster truck chassis is a pretty intricate structure made up of metal tubing that's all welded together. The chassis is kind of the backbone of the monster truck and of a car. And the way we put them together is a lot more complex than a car. So a car, the chassis is pretty simple. It's usually just like one layer of all these bars, and everything is mounted onto that. With a monster truck chassis, it's 3D.

MARC SANCHEZ: So instead of a flat rectangle you might see on a car, a monster truck has a three-dimensional skeletal shape. It's of the entire truck. It goes all the way up and over Rosalee when she drives too.

ROSALEE RAMER: You've probably seen him roll over once in a while. And so safety is a big factor for the driver. So our chassis ties in everything, all of the parts, including the cab that the driver sits in, and encompasses the driver so that when you roll over, nothing happens.

MOLLY BLOOM: Good news for drivers who like to fly through the air.

MARC SANCHEZ: Yeah, Rosalee can jump her truck 30 feet into the air. That's like jumping off of a three story building I said earlier that Rosalee has a really aggressive driving style. And what that means, basically, is she likes to go really fast. And when you're doing that and turning in these giant trucks, they tend to want to tip over. And it was because of that that Rosalee and her dad came up with some special modifications to her truck.

ROSALEE RAMER: My truck has a very low center of gravity. So it sits really, really low to the ground. With a lower center of gravity, you're not tipping the truck as much when you turn really fast. So I can use a lot of throttle when I'm turning. And instead of tipping the truck over, it'll kind of slide into a turn. Or if I go off a jump a little bit sideways, because of that low center of gravity, once again, it'll kind of stick low to the ground and land correctly instead of tipping over.

MARC SANCHEZ: In addition to racing and doing tricks at monster truck shows across the country, Rosalee is getting her mechanical engineering degree from Georgia Tech.

GABRIELLA HARPER: Wow, she's really putting her years with monster trucks to use.

MARC SANCHEZ: Yeah, and there's still a little time for fun. Like right now, she's learning a new trick where she kind of flips her truck sideways. The trick is called a corkscrew.

ROSALEE RAMER: To corkscrew, you go off a backflip ramp with only two wheels, but in order to propel your truck into that twist to land back on your front wheels, you actually turn your rear wheels as you're going up the backflip ramp. I was the third person to ever try one, and I have yet to land it, but I've only tried it once. I was probably about 3/4 of the way through the corkscrew, and the side of my rear tire hit the ground first. And I was still on the throttle, so it was still spinning.

So when that rear tire hit the ground, it actually, since it was still spinning, kind of slammed my roof into the ground instead of like letting me flip the rest of the way over. So I ended up on my roof, but there will definitely be another try.

[MUSIC PLAYING]

CHILDREN: Brains On! Woo-hoo! Woo!

MOLLY BLOOM: OK, back on the road and back to that mystery sound. Let's hear it one more time.

[WATER SLOSHING]

All right, any new thoughts?

GABRIELLA HARPER: I don't think so. I think I'm going to stick with a thunderstorm.

MOLLY BLOOM: All right, here with the answer is Gehrig, Alice, and Audrey from New York.

GEHRIG: This is the sound of our car going through a car wash.

ALICE: In the car wash, your car gets clean and there's a lot of noise.

AUDREY: When the light turns green and the sign says go. When it says stop, the red light comes.

MOLLY BLOOM: So you were close.

GABRIELLA HARPER: Oh, wow.

MOLLY BLOOM: I mean the rain coming down would sound a lot like being in a car wash.

GABRIELLA HARPER: Yeah, now it makes sense.

MOLLY BLOOM: Have you been inside a car wash before?

GABRIELLA HARPER: Yes, I have. It's so cool. I love it because this soap looks like a rainbow and--

MOLLY BLOOM: Yeah, it is awesome.

GABRIELLA HARPER: Yeah.

MOLLY BLOOM: Now, Gabriella, we have one more stop on today's leg of the road trip, and it's not a car wash.

GABRIELLA HARPER: Oh, yeah, Motor City.

MOLLY BLOOM: That's right, Detroit.

GABRIELLA HARPER: The center of automaking in the US and where we get to speak with Ralph Gilles.

RALPH GILLES: So my name is Ralph Gilles. I'm Head of Global Design for Fiat Chrysler Automobiles. And I get to design for Chrysler, Dodge, Jeep, RAM, Alfa Romeo, Maserati, and Fiat cars.

MOLLY BLOOM: You may have seen the new Pacifica minivan or maybe you're even in one now. Ralph designed that, but he's probably most known for designing the Chrysler 300. It's a sporty sedan with a distinctively large front grille.

GABRIELLA HARPER: And he's had a hand in designing lots of cars. Welcome, Ralph.

RALPH GILLES: How are you doing?

GABRIELLA HARPER: OK, so my first question is, generally, what does a car designer do?

RALPH GILLES: OK, so a car designer, it's an art career. So we sketch anything your eye can see when you look at a vehicle, stuff as dramatic as the entire shape of the car to the instrument panel. And nowadays, we're getting even more involved with the electronics in the car, how those look. So it's a pretty cool career that gets to touch a lot of aspects of the vehicle.

GABRIELLA HARPER: Wow, that's so cool.

RALPH GILLES: Yeah, and we work in teams. We work in teams of sometimes up to four or five people are responsible for one vehicle. Then we work side by side with a huge team of engineers. So it takes at least 1,500 people to get a car on the road.

GABRIELLA HARPER: Wow.

RALPH GILLES: Yeah.

GABRIELLA HARPER: When did you first start to notice the look and feel of cars?

RALPH GILLES: Oh, when I was a kid. When I was, basically, about 6 years old, I noticed cars. I noticed some looked better than others. I noticed some were actually kind of ugly. I didn't like the way they looked. You'd walk by them and be like, why is that car so ugly or boring? And then other ones were like, wow, it's so beautiful. And I felt a huge difference in happiness or emotion or whatever you want to call it when I looked at certain cars.

GABRIELLA HARPER: So those cars that you like, what specific parts were your favorite?

RALPH GILLES: The first thing I notice in a car is the shape. Is the shape kind of sleek? Does it look like it cuts through the wind? If you think of some of the most beautiful fish, they have to swim through water, and they're shaped a certain way. And cars have to swim through the air. So they have a certain shape. Some of the fastest cars, like supercars like Lamborghinis and Porsches and even Vipers, they have a certain shape because of that.

So it makes them look a little more futuristic. But sometimes, a Jeep can be also interesting. How tough does it look? So every car has a bit of a personality.

GABRIELLA HARPER: Who are you designing for, drivers, passengers, people on the street?

RALPH GILLES: Kind of everyone. That's the thing. Our sports cars are all about the driver. They're all about getting that thrill. And then our vehicles, like our trucks, are about working hard and pulling things. And the minivan is about making the family safe and entertaining the kids and carrying all kinds of stuff. So they're very different. We interview our customers a lot. And when we sit and ask them questions, they usually tell us what they're missing.

We try to anticipate what they don't have today and try to give it to them.

GABRIELLA HARPER: What are the notable innovations in car design, like turning points where you might be able to trace some current ideas from?

RALPH GILLES: Well, that's a very good question. I think car design is evolving very rapidly. And what happens with cars, there's technologies that come around. I'll give you an example. Like when I was growing up, there was really only two kinds of headlamps. There were square headlamps and round ones. Today, if you look at cars, their lamps are very different.

Every single car has a unique set of headlamps, and within the headlamp, it's even more unique because the technology, especially nowadays, we're using LED lights, which are very small and easy to package, that's one of the things. Molding technology allows us to do shapes that we could only dream of 10 years ago. And what we're finding now is that technology from the tech industry is really finding its way into the automobile.

GABRIELLA HARPER: What will the cars of the future be like?

RALPH GILLES: That's the kind of question that keeps me up at night, what will cars be in the future? I think we're still going to have cars for a very long time. I think they're going to continue to get smarter. I think if you look at a lot of the sci-fi movies, they always show cars almost being like people, almost being like very smart. And I think that's the way the future will be. Your car will feel almost like your best friend where you can talk to it and you could ask it to do stuff.

And some of them will drive themselves. Some of them will help you organize your day, will help you if you're lost, kind of things. But I think cars are going to get really, really, really smart and be even more fun to have and to own.

GABRIELLA HARPER: Do you think you would be able to design a flying car?

RALPH GILLES: Wow! The only problem with that is once you start flying stuff, then you have to use airplane regulations, which are really, really tough. I don't know if you know this, but airplanes take 20 to 25 years to design. So it's a whole different challenge. So I think we'll stay on the road for now.

GABRIELLA HARPER: Wow. Thank you.

RALPH GILLES: Awesome. It was great talking to you. And hopefully, you learned something from me.

GABRIELLA HARPER: I did. I did.

RALPH GILLES: All right. You take care. And dream big, OK?

GABRIELLA HARPER: Thank you.

[MUSIC PLAYING]

The first mass-produced cars looked pretty similar. Ford's Model T famously only came in black.

MOLLY BLOOM: The more popular cars became, the more innovations, like windshield wipers.

GABRIELLA HARPER: Car designers take cues from all over to come up with these new styles.

MOLLY BLOOM: Cars and monster trucks have chassis, but a monster truck chassis is 3D.

GABRIELLA HARPER: Which can be a big help when you find yourself falling 30 feet and rolling onto your roof.

MOLLY BLOOM: That's it for this episode of Brains On.

GABRIELLA HARPER: Brains on is produced by Marc Sanchez, Sanden Totten, and Molly Bloom.

MOLLY BLOOM: We had technical support from Michael DeMarc, Zach Rosen, Roger Smith, Steve Griffith, Veronica Rodriguez and Erik Stromstad. Special Thanks to Carolyn Harper, Rebecca Moore, Eric Ringham, Hans Buetow, Mike Mulcahy, Christine Hutchins, and Perry Lee.

Now for one last stop on this Road Trip episode. This one is for all of you who have sent in questions, drawings, mystery sounds, and high fives. Here's the latest group to join the Brains Honor Roll.

[LISTING HONOR ROLL]

We are right in the middle of our road trip. There are two more episodes coming in this series. So keep an eye out for them. And remember, if you sign up for the Brains On newsletter, we'll send you a link to our exclusive car fun activities. Head to BrainsOn.org And click on Newsletter and let the good times roll.

[CAR HONKS]

GABRIELLA HARPER: Thanks for listening.